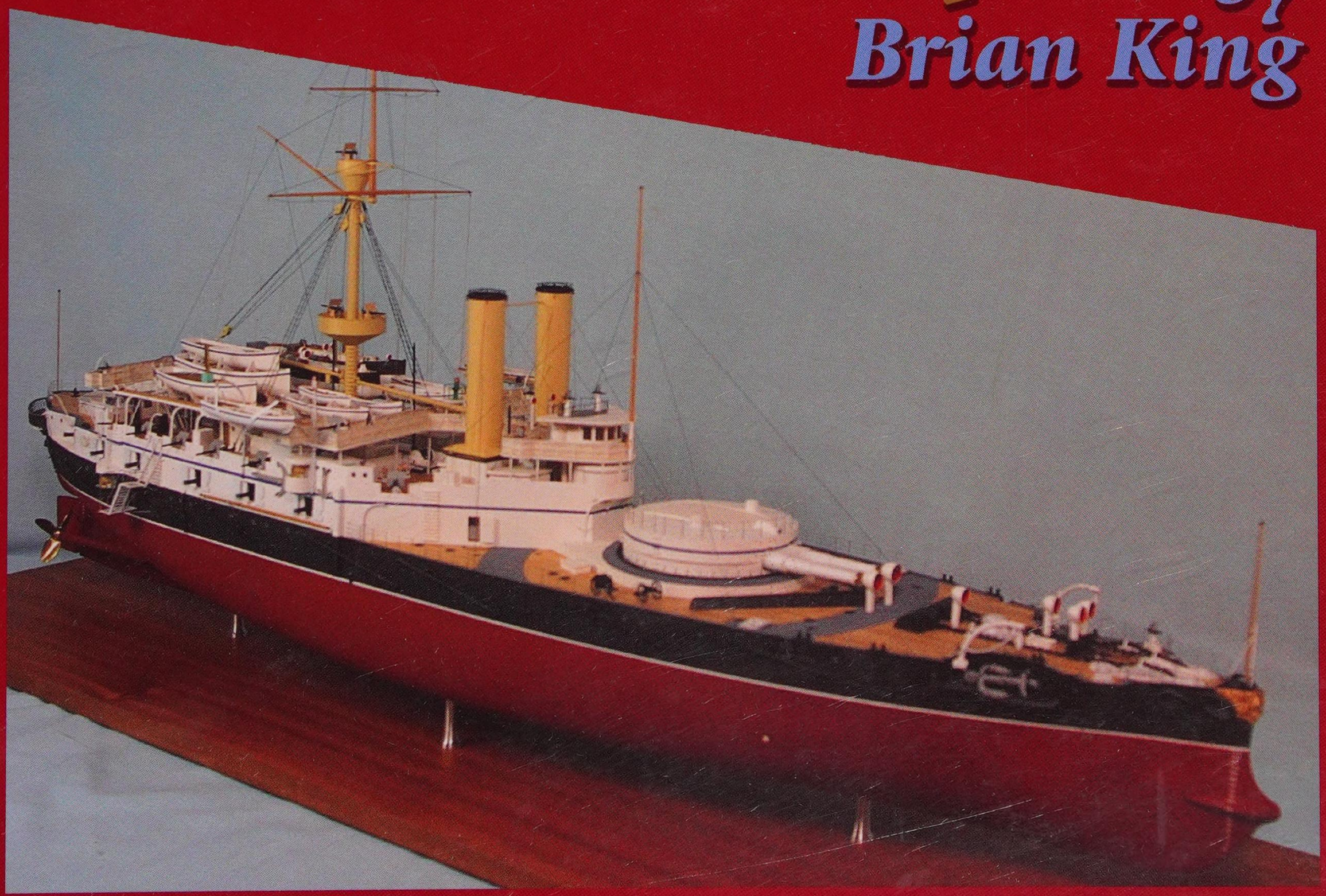
Modelling Late Victorian Battleships

by Brian King



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Brian King

"You must always believe you will become the best, but you must never believe you have done so." – Juan Manuel Fangio

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Acknowledgments

As with my two previous books *Advanced Ship Modelling* and *Photo Etching* my greatest thanks must go to Azien Watkin who put my words, very messily written, into the computer. She also did a great deal of the photography and, with my help, the drawings. Without her I think this book would never have got to the Caxton bit!

My thanks must be extended to Bob Friedman and his colleagues for taking on the job of publishing my work and answering my endless questions. Some people do go beyond the call of duty!!

It was very nice to work with Scottie Dayton again when she did the page-setting.

Acknowledgment must be made of friend, Jürgen Eichardt who drew the magnificent set of plans from which *Duilio* was built and which started the whole process. Having been used to MOD (Ministry of Defence) plans, which are of no real help to the modeller detail wise, working to Jürgen's plans was a real pleasure. He also gave me a great deal of help with my research.

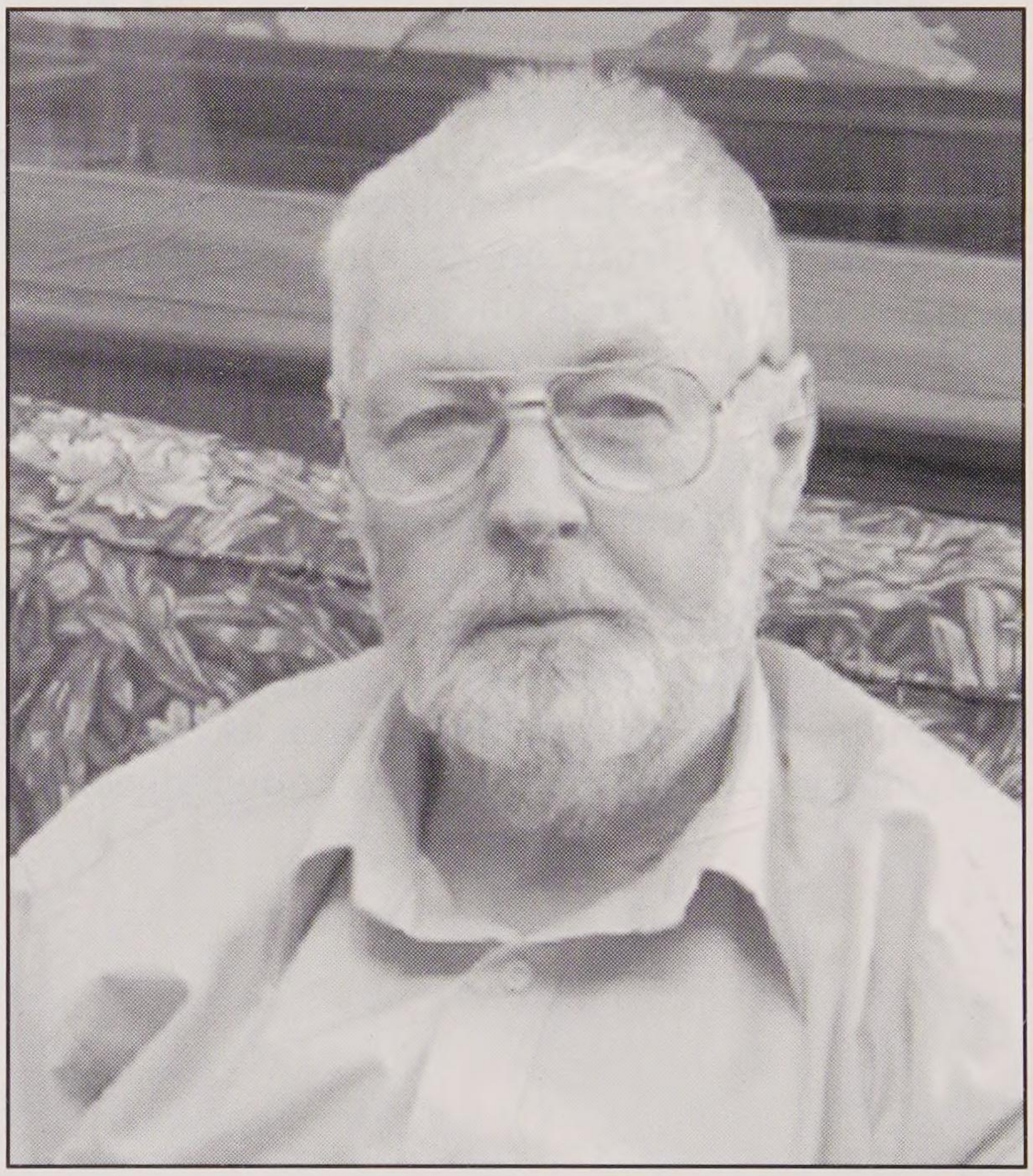
As is usual my great friend John Roberts was always there to answer endless questions about the four British Victorian battleships discussed in this book. As in the past for more years than I care to remember, Dave Sambrook has been one of those kind friends on whom I could rely for any kind of modelling help.

As always, advice and help with the computers came from David Watkin and his colleagues, especially Richard Willmott, and boy did we need it at times! Christopher and Callam have always been there for me whenever I needed support. The model of *HMS Inflexible* was built by my good friend John Prothero-Thomas who very kindly allowed us to photograph it. This model, which is a miniature, won a gold medal at our Model Engineer Exhibition.

It has been an all-round challenge as, for the first time, we have had to wrestle with a digital camera and all that implies with its associated computer work. We have even modified photographs with the computer's help.

I only hope that it gives pleasure to those who bother to work through it and perhaps it may improve their modelling skills a bit. It may also throw a bit of light onto the history of what I consider the most interesting period of naval development.

– Brian King, Weybridge, 2001



Preface

I was editing equine magazines when the horse industry suffered an economic crash in 1979 and subscriptions evaporated overnight. Desperate to keep his company alive, the publisher purchased the subscriber list to a defunct model shipbuilding magazine and appointed me editor.

In time, many of my writers were also the best shipmodellers in North America. Then, in late 1982, Brian King sent a query asking if I'd accept a column of shop hints he was prepared to author. "Brian King's Workshop" enhanced the pages of *Ships in Scale* through 1987, when he took a hiatus from writing owing to a serious illness.

During those years, I marveled not only at his level of expertise, but his ability to concisely explain techniques while encouraging readers to try them. His approaches to solving sticky modelling problems were ingenious, yet often appeared simple. One letter from an accomplished builder summed it up. "It's so obvious once Brian King explains it that I wonder why I didn't think of it. That's when I realize how extraordinary and gifted this man is. If it were such an easy solution, more people would have thought of it."

Another trait is Brian's sense of humor, which surfaces throughout whatever he writes. Any reader soon feels he knows the man, and the man is human. Brian shares his failures as openly as his victories, which he barely acknowledges. All the while he took home gold medals from the Model Engineer Exhibition, Naviga, or wherever else he entered his stunning Victorian battleships, our conversations focused on how he wasn't going to make the same mistakes on the next model.

This book, a sequel to Brian's *Advanced Ship Modelling*, serves a dual purpose. You need not build a model of a late Victorian battleship to appreciate its wealth of construction techniques. Everything is written for the modeller working with today's materials and tools. And, I hasten to add, in a bedroom-sized workshop.

Prior to *Advanced Ship Modelling*, however, precious little appeared in print on modelling Victorian battleships. Brian has condensed years of frustrating research into a paragraph or line drawing. He's peered into all those black areas on old photographs and determined to the best of anyone's ability what features lay hidden in the shadows. His knowledge of the subject is unsurpassed.

In sharing his research, talent, and ideas, Brian will challenge your mental and manual dexterity. He'll elevate your level of modelling by placing more techniques at your fingertips. Experiment. Expect some failures, but also expect more enjoyment and a deeper sense of accomplishment from your modelling.

– Scottie Dayton

Dedication

This book is dedicated to the men who served on the Victorian battleships described herein. One of them, *Victoria*, was sunk when rammed by her contemporary *HMS Camperdown* with the loss of more than 300 lives. Most of these ships served at a time when Great Britain was at peace and, consequently, never fired a shot in anger. Nevertheless, world peace was dependant on their presence.

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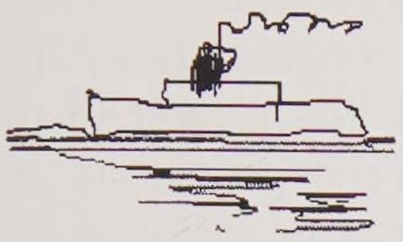


Chapter One

Introduction

For those of us who build model ships, there are no lack of subjects – rather the contrary – and most of us specialise in one type or another. Some like lifeboats and, even here, in what to some may seem a fairly restricted sphere, the choice is vast – early lifeboat pullers and sailers, righting and non-righting, and modern high speed jobs not to mention foreign lifeboats. Most maritime nations now have a lifesaving service often run by the state and not as a voluntary service as is our own Royal National Lifeboat Institution (RNLI).

If you like "stick and string," then again the field is wide. Most model exhibitions show a variety of ship types, but one period that seems to be largely ignored is that of the late Victorian from 1870 to 1900. By this time the steam engine of the reciprocating piston type had established its superiority and versatility over wind power, and gone were the complicated masting and rigging that were essential for supporting sails, thus making a "cleaner" model.

The British Royal Navy's (RN) battleships from this period make exceptionally fine models. As a guide, the later in the period the more complicated the ships become. For instance, *HMS Devastation*, launched in 1871 and shown in **Figs. 1-1** to **1-3**, is a relatively simple ship compared to *HMS Magnificent* (1894) which is very complicated. *HMS Devastation* and her rather ill-fated sister ship *HMS Thunderer* were originally designed by Reed, but altered after his resignation by Barnaby.

(*Thunderer* had a boiler explosion during her trials in July 1876 and a gun explosion in January 1879 with 11 killed and 30 injured. During her time in the Mediterranean from March 1891 to September 1892, she had constant trouble with her boiler tubes and, as a consequence, was sent home to Chatham, paid off, and reduced to Reserve. The cause of the gun explosion was a double loaded gun. It seems one gun misfired and another charge was rammed without anyone noticing the misfire or how far the rammer went into the gun the second time.)

They were revolutionary ships having quasi-monitor hulls with very low freeboard, excellent armour, and large calibre weapons. They also had very little rigging. At first public opinion and some critics condemned them, but they became very popular at the end of their commissions. In truth they were not very efficient, as in any sea their low freeboard required battening down, giving their crews a very bad time. They were therefore restricted to home waters and did no long journeys. They would certainly have been hard hitting ships and able to take much punishment if they had ever had to fight, although their ability to fight in rough conditions owing again to their low freeboard is in doubt. All this is rather academic, as they never had to fight.

The period in question was largely peaceful – certainly in the naval sense. The *Pax Britannica* reigned supreme largely, if not completely, due to the supremacy of the Royal Navy. The other point to remember is that until the early 1900s, the

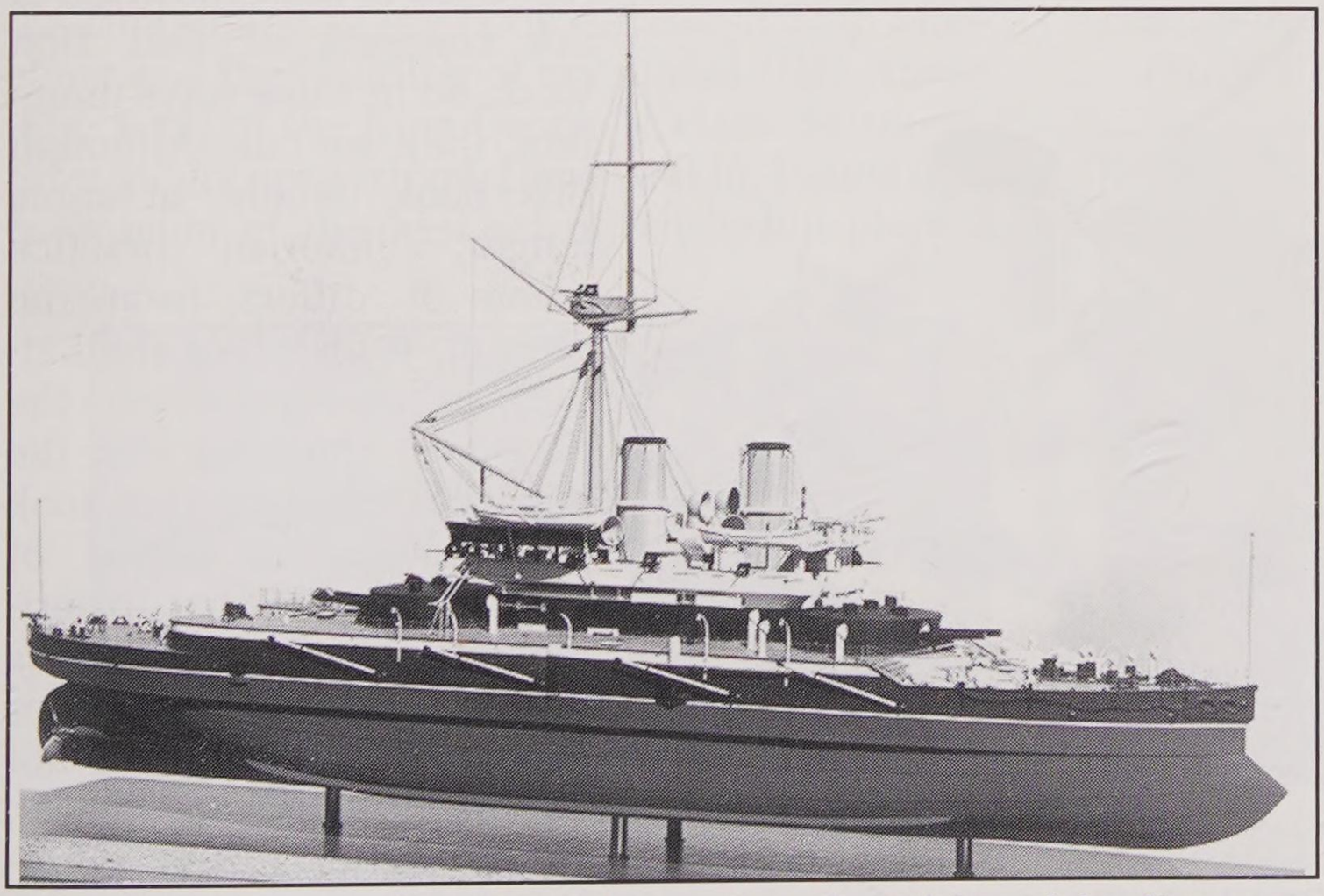


FIG 1-1: *HMS Devastation* of 1871 shown after refit with breech-loading guns.

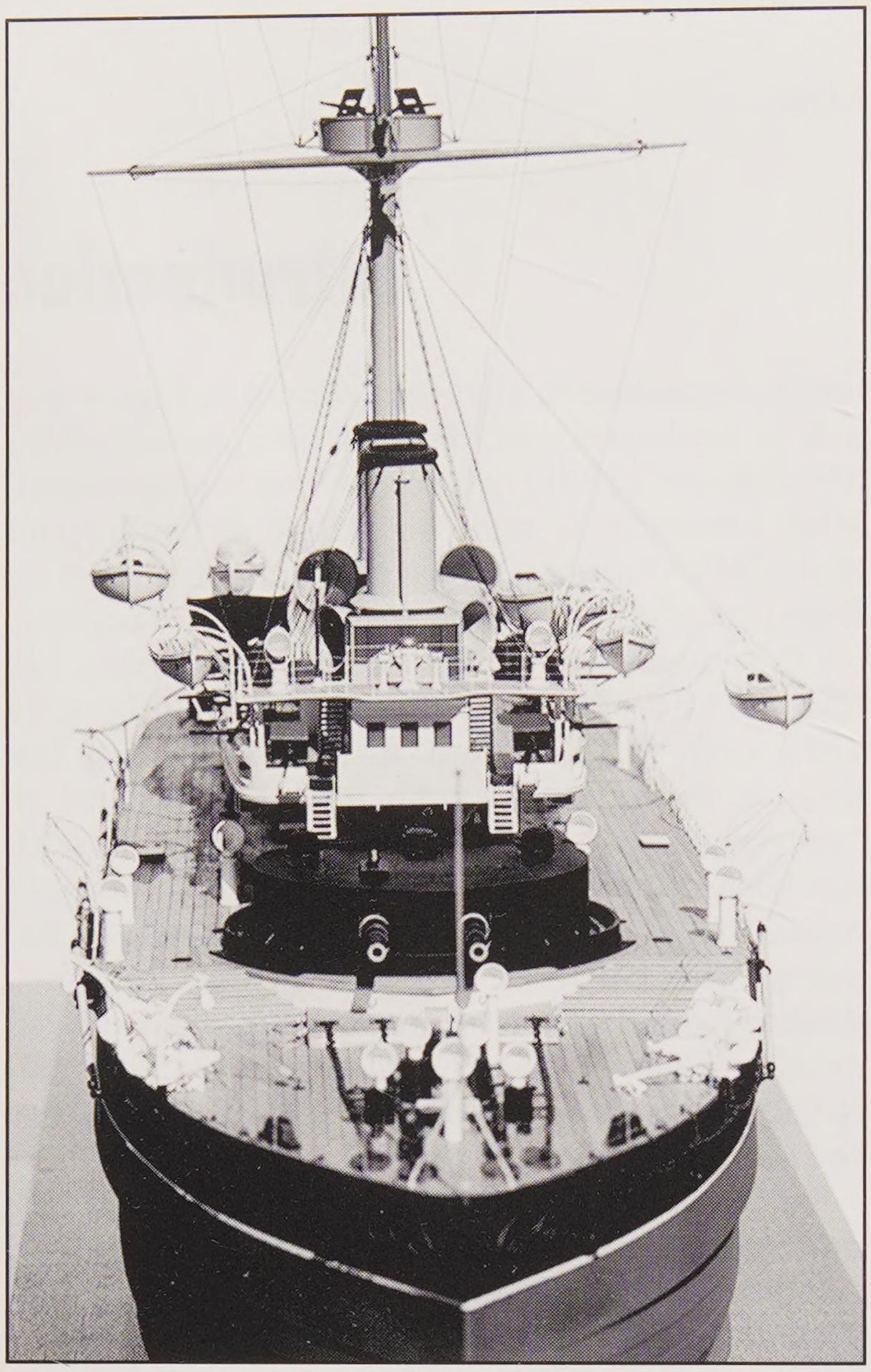


FIG. 1-3: *HMS Devastation* – bow shot.

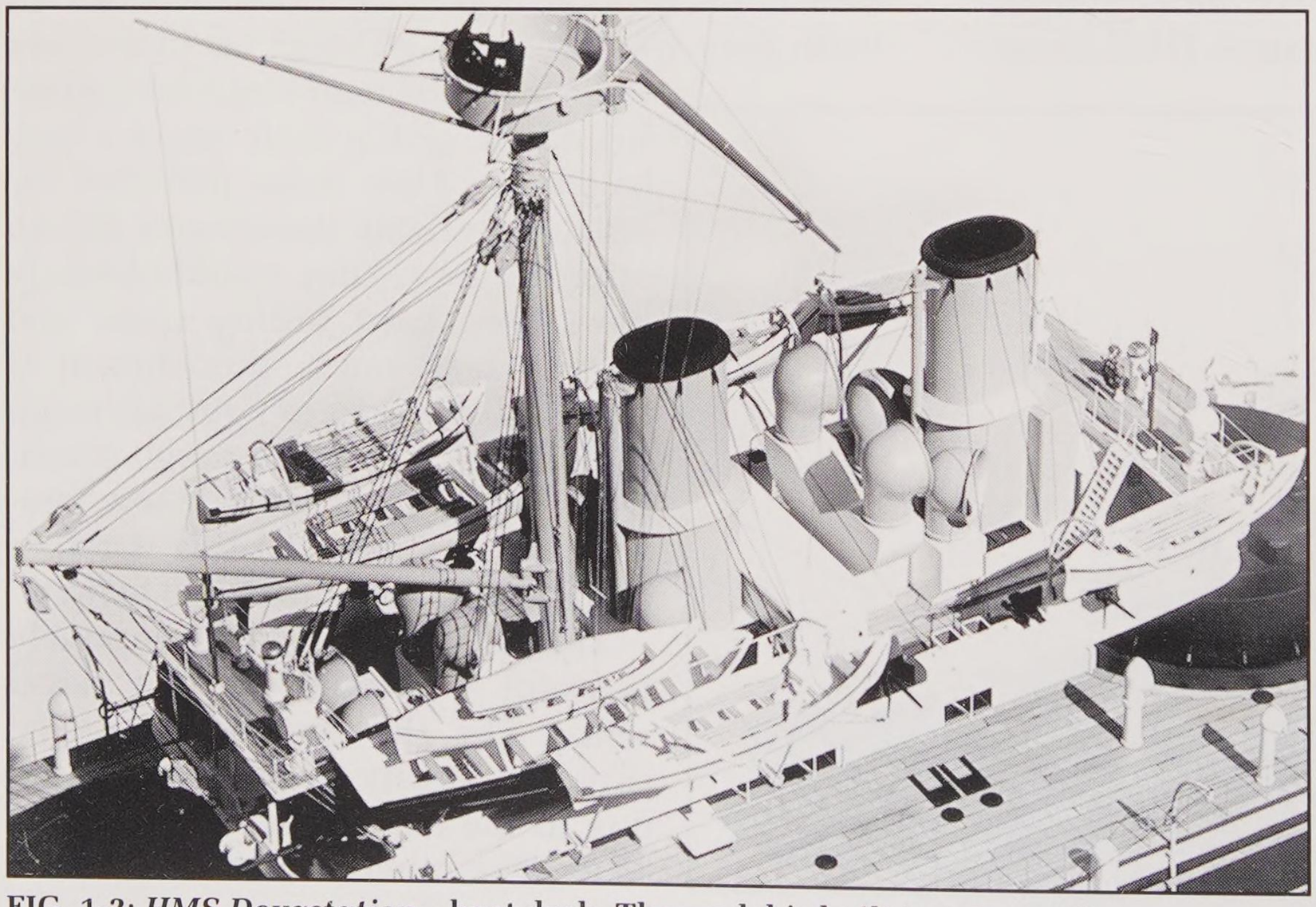


FIG. 1-2: *HMS Devastation* – boat deck. The model is built to 1:110 scale.

main enemy was seen to be the French and what they did affected our building programme. After 1900, due to Parkes and others, the power of recently united Germany became recognised as the real enemy. Our attention became focused on their naval progress and the French became our allies.

I have built models of *HMS Devastation* (1871) **Fig.1-1** to **Fig.1-3**, *HMS Empress of India* (1891) **Fig.1-4** c/s (colour section) and **Fig.1-5**, *HMS Victoria* (1887) **Fig.1-6** and **1-7** c/s, *HMS Magnificent* (1894) **Fig. 1-8**, **Fig.1-9** c/s, and **Fig.1-10**, and finally *RN* (Regia Marina) *Duilio* (1876) **Fig 1-11** c/s and **Fig.1-12**. All except the last are Royal Navy ships, *RN Duilio* being a ship of the Italian Navy.

Another advantage of building battleships before 1903 is their livery – black, white, and buff which looks better than the universal grey adopted, at least by the Royal Navy, after 1903. The reason for the colour change was that the Victorian livery made ships stand out like "beetles on a tin tray" in some atmospheric conditions as some Admiral remarked.

This book is really a sequel to my first book *Advanced Ship Modelling*. In that book I tried to put into words what building ship models means to me, detailing not only the practical side, my ideas and methods, but also my philosophy; that which makes me build complicated models of ships.

If the first book was the gospel according to BK, then this book is the exposition of the contents of that first work. So in some ways therefore, they are one. Although this book details, at some length, Victorian practice where it differs from the present, it also lists the battleships launched during the period in question and the pertinent changes that took place during a period of enormous growth, experimentation, and sometimes disaster. When you consider all this work was done, not under the influence of war, which is usually the hothouse driving improvement,

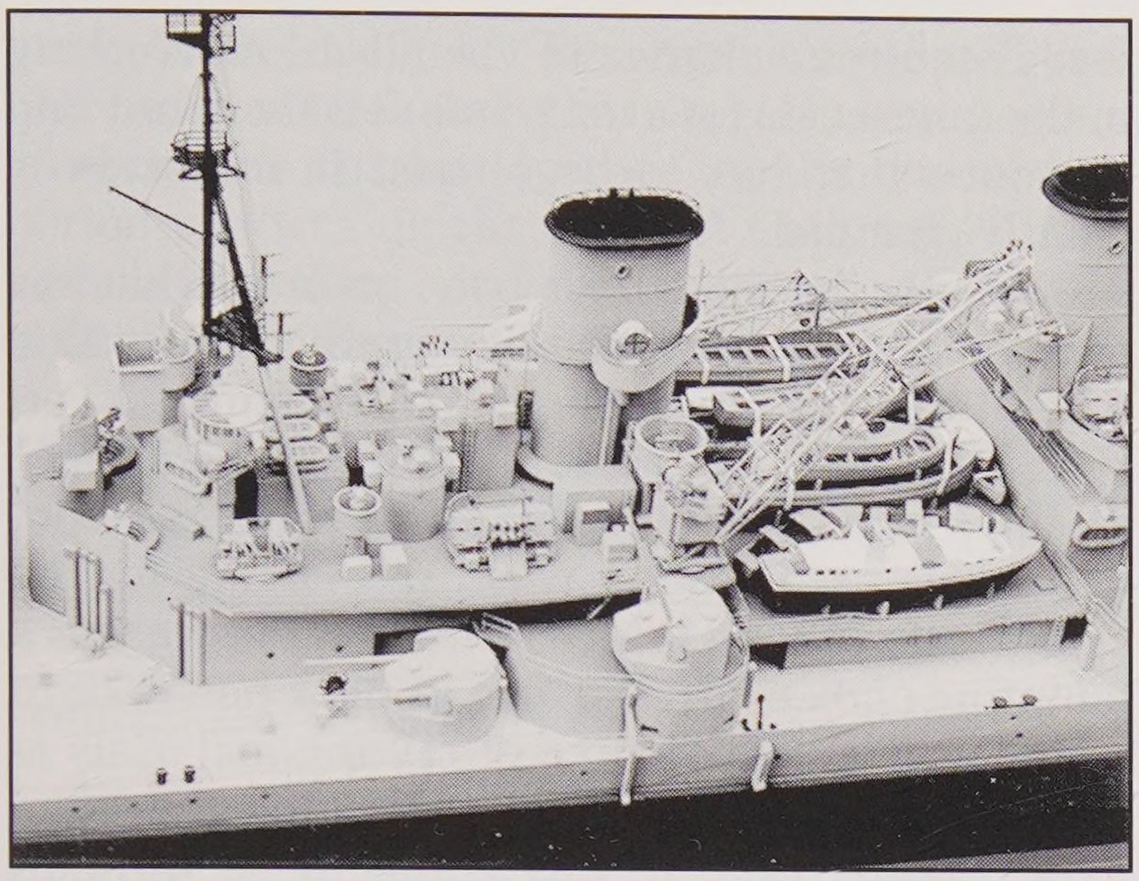


FIG. 1-13: My model of *HMS Anson* (1942) at 1:192 scale.

but during peace, it was a remarkable era. (The RN was not involved in any major sea battle between Trafalgar 1805 and the Dogger Bank in 1915).

Although this book is a general exposition of modelling late Victorian battleships and Victorian practices are going to be described, it was thought that an example would illuminate the actual modelling and the Italian battleship *RN Duilio* (1876) was chosen as the subject. Photographs of the other four battleship models I have produced will also be used to illustrate the text.

The selection of *RN Duilio* to illustrate modelling points in this book came about in two ways. Firstly, it was the first large model to be built after the completion of my book *Advanced Ship Modelling* and the building of my model *HMS Anson* (**Fig. 1-13**) of the King George V class. Secondly, through my great friend, Dave Watkin, I came into possession of the best set of battleship plans I have ever seen. Working to Ministry of Defence (MOD) plans as I usually do always involves hours of research to find the missing details not shown on the drawings. One must remember that original plans do NOT cater to the modeller in any way. Their purpose is different and, one might say, much more serious! So detail is often of the "outline only" type, if that, and the actual bits are just not there.

When I first saw the set of drawings prepared by Jüergen Eichardt showing not only the lines, cross sections, detailed sheer and plan, but also every part drawn out, it was, you might say, the road to Damascus all over again. All one had to do was to make it, for it was all there down to really fine detail. A real ship modeller's Shangri-la.

Duilio, named after the Roman Consul Gaius Duilius who invented a new kind of boarding gangway in 260BC, is of the same arrangement as the British *HMS Inflexible* (**Fig. 1-15**) of 1870. *Duilio* had two large, almost circular turrets arranged en echelon (diagonally across the ship's waist as in **Fig. 1-16**) with a flying deck above them. *Duilio* had a single fighting topmast with no rigging and a large deckhouse on the quarterdeck. *Inflexible* was built with a set of sails showing the Royal Navy's innate conservatism. Later this rigging was simplified.

The object of the turret arrangement en echelon was to allow both turrets to fire a broadside; i.e., one turret firing across the deck. In practice this was found to cause so much blast damage to deck fittings that it was impossible.

Duilio's most distinguishing, but almost hid-

FIG. 1-15: John Prothero-Thomas' waterline model of *HMS Inflexible* at 1:384 scale.

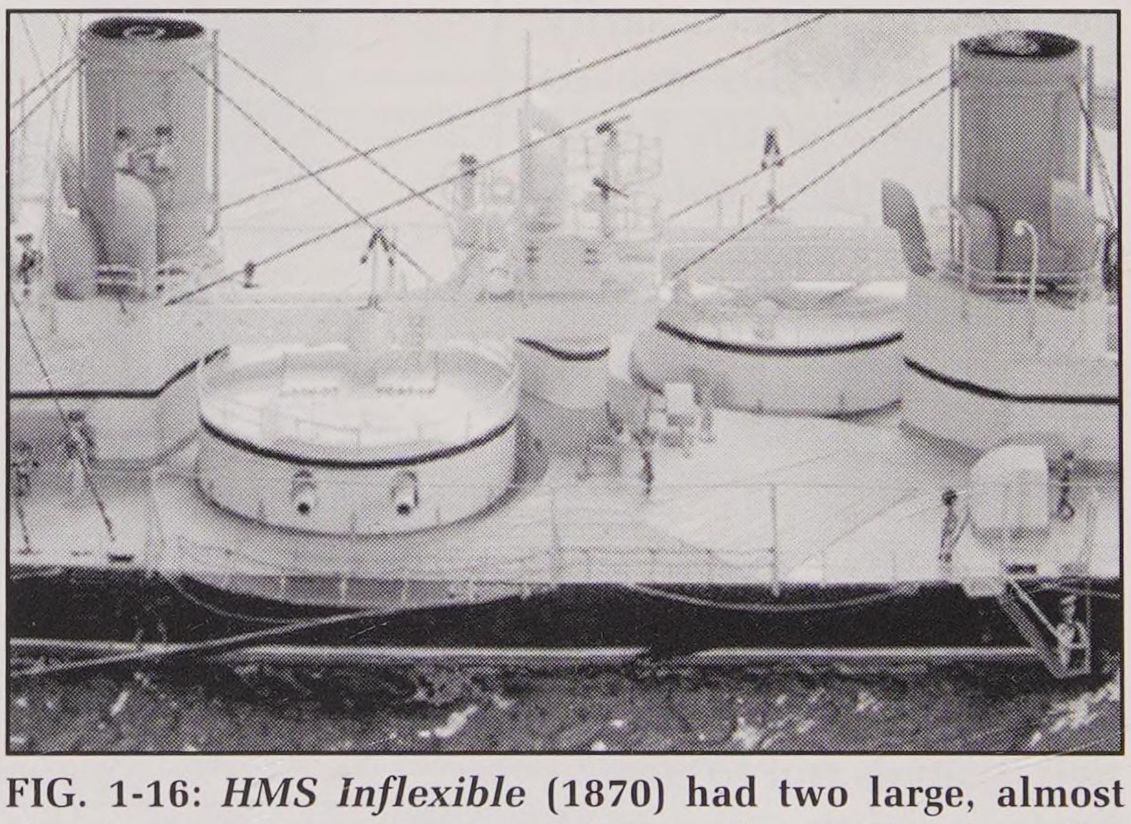


FIG. 1-16: *HMS Inflexible* (1870) had two large, almost circular turrets arranged en echelon (diagonally across the ship's waist).

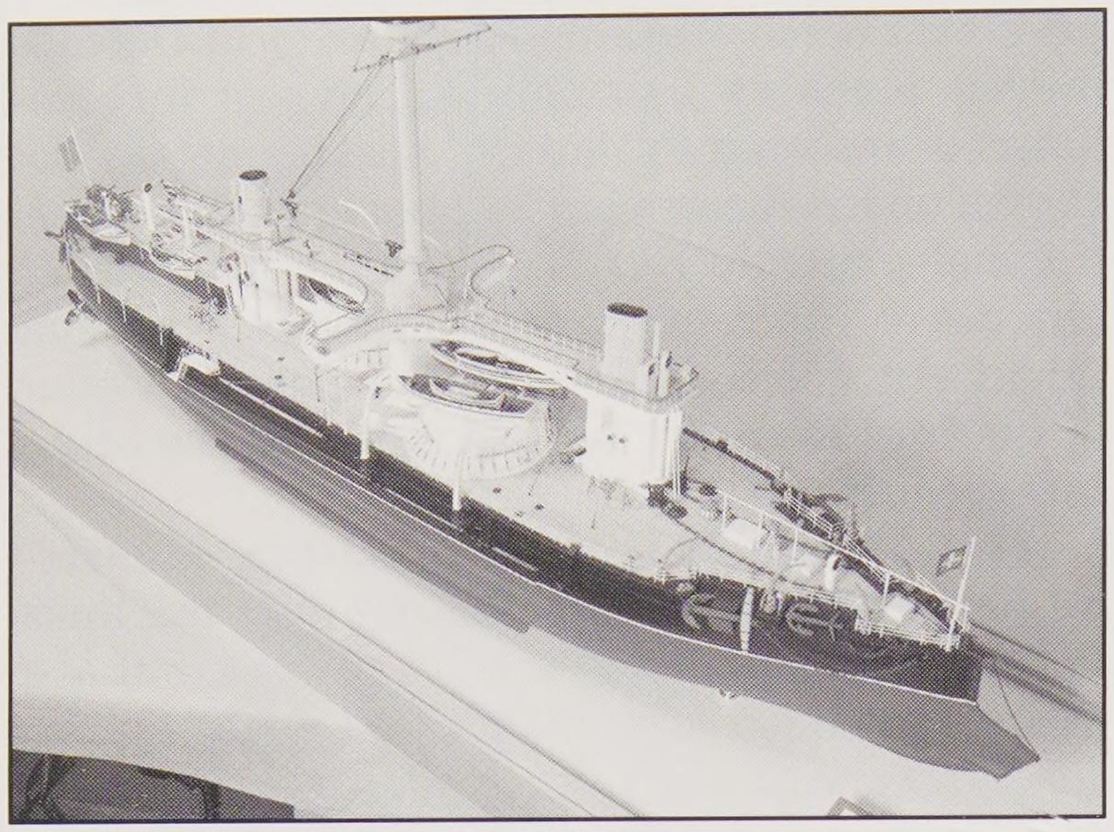


FIG. 1-19: Plan view of *Duilio* (1876).

den, feature was the clam opening stern housing a floating torpedo boat (**Fig. 1-17**). Torpedo boats were the "in thing" in the 1870s – or the fear of them was. As subsequent class vessels did not have this feature, we can only assume the idea was not a success. At least one of the torpedo boats *Duilio* carried was made by Thornycroft (**Fig. 1-18**). Building a model of this vessel is dealt with in chapter nine.

Duilio's whole design was delightfully over-complicated. The main turrets appeared to be circular, as has been said, but on closer examination they were constructed from four circular overlapping arcs to produce a slightly oval shape. One wonders why the complication? In all sorts of ways the design of this vessel is unnecessarily flowery, but this makes for a more visually interesting model, which is what static modelling is all about, although some modellers do make the most extraordinarily ugly vessels. Why is beyond me.

The model is made to the metric scale of 1:100 which is so near to English 1: 96 as not to need a basic rethink. Changing scales in model work always requires a change in visualisation. Working to the same scale for a long time sets the mind into a groove that has to be altered if the scale is greatly changed.

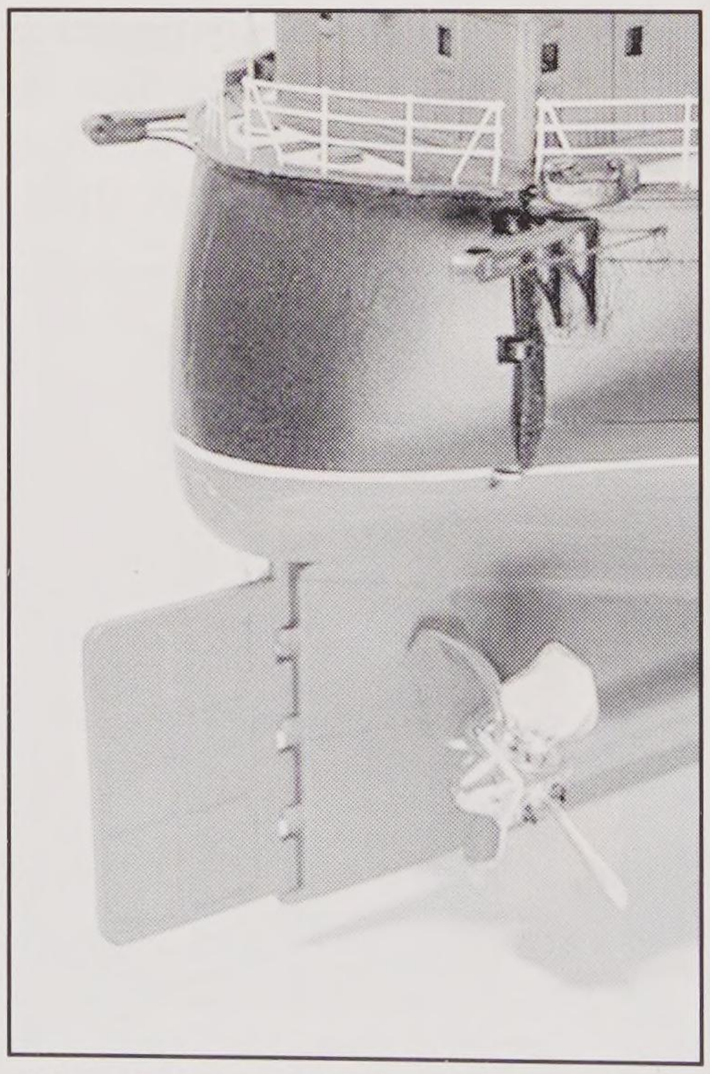


FIG: 1-17: *Duilio's* clam opening stern.

Basically the model has been built to what has become my usual method of working. The hull is of jelutong with the superstructure mainly of Perspex (Plexiglas) and custom-made brass etchings. Custom means that I draw them; they were not bought items. Plywood was used largely for the complicated flying bridge structure. Plastic was a tempting choice but, because its deck had to be of wood anyway, my dislike of mixing materials at least over a length (i.e. gluing them together) dictated against this. It was going to be difficult enough to keep its flimsy structure stable anyhow. The trouble here was that a good finish had to be built up on wood. Something I avoid if possible – it means work!

The model was built as *Duilio* appeared in 1876 when she was equipped with 450mm muzzle-loaders. They were the most powerful guns specified up to that time, but could not fire more than four rounds per hour even with experienced gun crews. The British company Armstrong's sold these guns to the Italians. Unknown to the Italians, the same company was developing a 406mm weapon that could fire every two minutes. One senses a little commercial chicanery afloat (**Fig. 1-18**).

Someone here had made a shrewd assessment of the backwardness of any Mediterranean adversaries and sold them obsolescent technology whilst making enormous profit. The eight giant guns cost the Italians 453,160 lire. To put that into perspective, each of their French-built armoured frigates of the Regia Marina Pia class, built some 10 years previously, had cost less.

So this book is about what for me is a marvellous period when Great Britain was su-

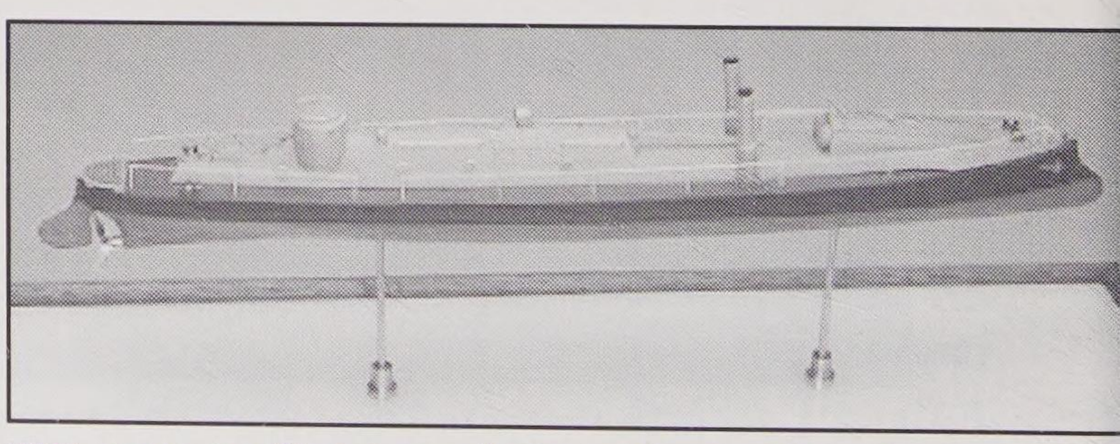


FIG. 1-18: *Duilio's* torpedo boat *Vespa (Wasp).*

preme with a Navy of "Two-Power Standard" that had parity with the next two largest naval powers (France and Russia) together. At the end of this period she was on the point of building 70 new vessels including seven battleships costing £21.5 million over the next five years under the Naval Defence Act of 1889.

A list of all British battleships built during the period under review (1870–1900) is appended. Surely you can find a ship in it that you *must* build? If not, you have to be very difficult to please indeed!

Late Victorian British Battleships 1870-1900

CLASS	NAME	LAUNCHED	DESCRIPTION	LENGTH
Audacious	*Audacious* *Invincible* *Iron Duke* *Vanguard*	27/2/1869 29/5/1869 1/3/1870 3/1/1870	Central battery ironclads.	280ft
Sultan	*Sultan*	31/5/1870	Central battery ironclad.	325ft
Swiftsure	*Swiftsure* *Triumph*	15/6/1870 27/9/1870	Central battery ironclad.	280ft
Alexandra	*Alexandra*	7/4/1875	Central battery ironclad.	325ft
Temeraire	*Temeraire*	9/5/1876	Central battery/barbette ship.	285ft
Belleisle	*Belleisle* *Orion*	12/2/1876 23/1/1879	Armoured rams.	245ft
Superb	*Superb*	16/11/1875	Central battery ironclad.	332ft
Cerberus	*Cerberus* *Magdala*	2/12/1868 2/3/1870	Coast defence monitor.	225ft
Abyssinia	*Abyssinia*	19/2/1870	Coast defence monitor.	225ft
Glatton	*Glatton*	8/3/1871	Breastwork monitor. • First British single turret ship.	245ft
Hotspur	*Hotspur*	19/3/1870	Ironclad ram.	235ft
Devastation	*Devastation* *Thunderer*	12/7/1871 25/3/1872	Turret ship.	285ft

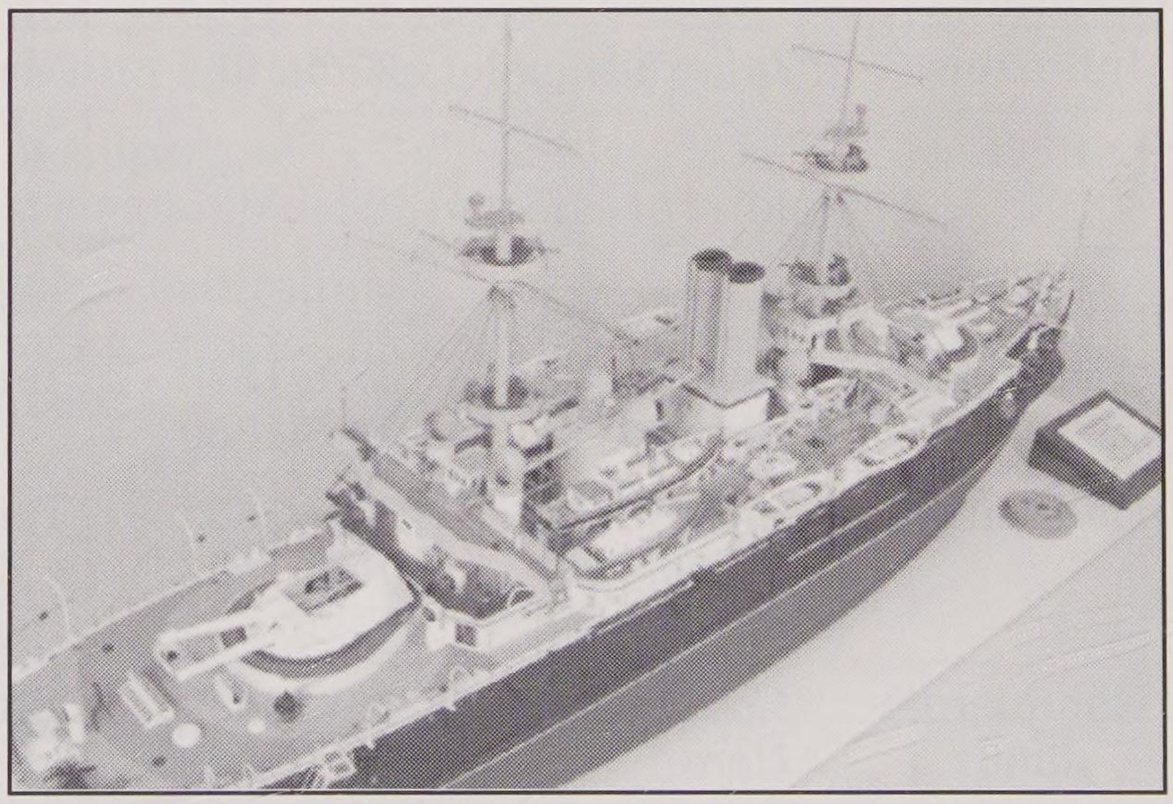


FIG. 1-8 (left) and FIG. 1-10 (above): Both are *Magnificent*.

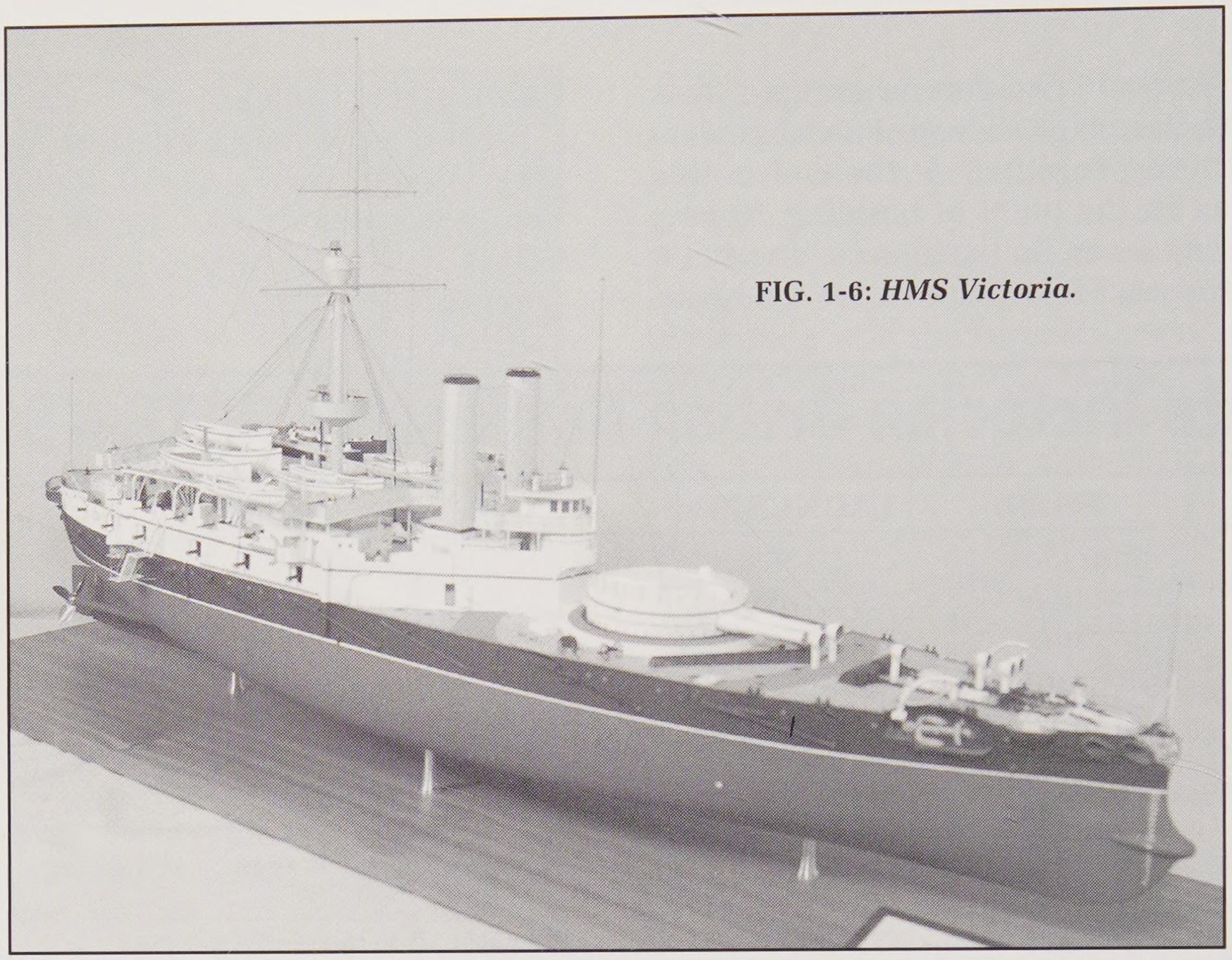


FIG. 1-6: *HMS Victoria.*

Rupert	*Rupert*	12/3/1872	Ironclad ram.	250ft
Dreadnought	*Dreadnought*	8/3/1875	Turret ship. • *Fury* was designed by Reed and laid down as such, but redesigned by Barnaby to incorporate lessons learned from *Devastation* and *Thunderer*. • Renamed *Dreadnought*.	320ft
Cyclops	*Cyclops* *Gorgon* *Hecate* *Hydra*	18/7/1871 14/10/1871 30/9/1871 28/12/1871	Coast defence monitors. • Built to protect coastal towns from attack by the French during the war scare of 1870. • Most unsatisfactory ironclad ever built.	225ft
Neptune	*Neptune*	10/9/1874	Masted turret ship.	300ft
Inflexible	*Inflexible*	27/4/1874	Masted turret ship. • Built in answer to the Italian battleships (e.g. *Duilio*). • Guns in echelon for nominal all-round fire.	320ft
Agamemnon	*Agamemnon* *Ajax*	17/9/1879 10/3/1880	Turret ships.	280ft
Colossus	*Colossus* *Edinburgh*	21/3/1882 18/3/1882	Turret ships. • Elswick breech loading mechanism adopted – return to breech loading.	325ft
Conqueror	*Conqueror* *Hero*	8/9/1881 27/10/1885	Turret rams.	270ft

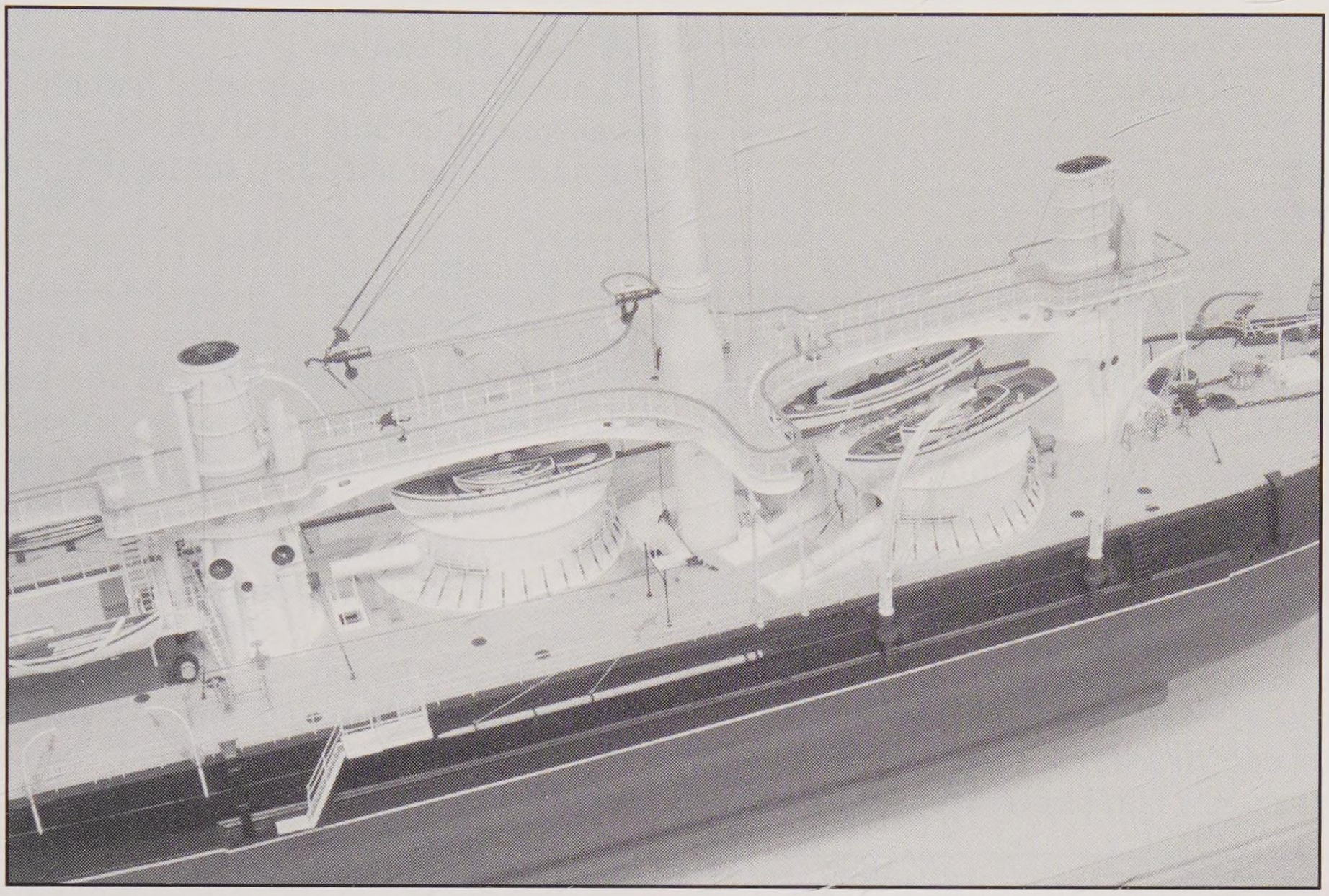


FIG. 1-12: *Duilio* amidships.

Admiral (1)	*Collingwood*	22/11/1882	Barbette ship. • First British battleship with breech loading guns in barbettes.	325ft
Admiral (2)	*Anson* *Camperdown* *Howe* *Rodney*	17/2/1886 24/11/1885 28/4/1885 8/10/1884	Barbette ship. • Final abandonment of sail power. • Four 13.5in 67ton breech loading guns in open barbettes.	330ft
Admiral (3)	*Benbow*	15/6/1885	Barbette ship. • First ship to carry 110ton breech loading gun in open barbette – one fore and one aft.	330ft
Victoria	*Victoria* *Sans Pareil*	9/4/1887 9/5/1887	Turret ships. • Two 16.25in 110ton breech loading guns fore. • One 10in 29ton breech loading gun aft.	340ft
Trafalgar	*Trafalgar* *Nile*	20/9/1887 27/3/1888	Turret ships. • Last single citadel turret ships to be built.	345ft
Royal Sovereign	*Empress of India* *Ramillies* *Repulse* *Resolution* *Revenge* *Royal Oak* *Royal Sovereign*	7/5/1891 1/3/1892 27/2/1892 28/5/1892 3/11/1892 5/11/1892 26/2/1891	First class battleships. • Four 13.5in guns mounted in open barbettes.	380ft
Hood	*Hood*	30/7/1891	Turret battleship.	380ft

Centurion	*Centurion* *Barfleur*	3/8/1892 10/8/1892	Second class battleships. • First battleships to have hooded barbettes with all-round loading positions. • Wood and copper sheathed for foreign service.	380ft
Renown	*Renown*	8/5/1895	Second class battleship.	380ft
Majestic	*Caesar* *Hannibal* *Illustrious* *Jupiter* *Majestic* *Magnificent* *Mars* *Prince George* *Victorious*	2/9/1896 28/4/1896 17/9/1896 18/11/1895 31/1/1895 19/12/1894 30/3/1896 22/8/1895 19/10/1895	First class battleships. • Largest class of battleship ever built. • Return to 12in guns.	390ft
Canopus	*Albion* *Canopus* *Glory* *Goliath* *Ocean* *Vengeance*	21/6/1898 12/10/1897 11/3/1899 23/3/1898 5/7/1898 25/7/1899	First class battleships. • Krupp armour. • Sponsoned casemates to obtain end-on fire. • 18 knots on natural draught	390ft
Formidable	*Formidable* *Irresistible* *Implacable*	17/11/1898 15/12/1898 11/3/1899	First class battleship.	400ft
London	*Bulwark* *London* *Venerable* *Queen* *Prince of Wales*	18/10/1899 21/9/1899 2/11/1899 12/3/1902 15/3/1902	First class battleships. • Selected for the first experiments in naval aviation during 1912.	400ft

WHERE TO BUY THE PLANS

Plans for *R.N. Duilio* can be obtained only from J. Eichardt at juergen.eichardt@inka.de

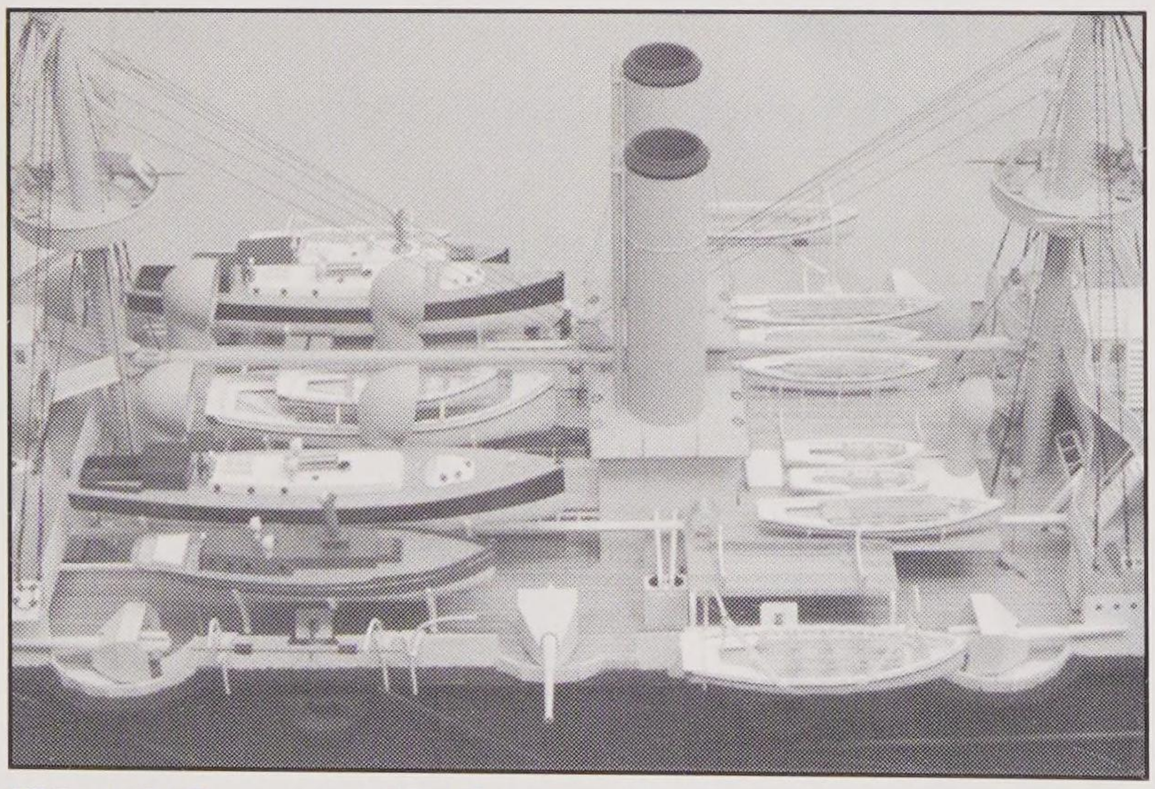


FIG. 1-5: *Empress of India* boat deck.

Plans for *HMS Devastation, Empress of India, Victoria, Inflexible* and *Magnificent* can be purchased from the National Maritime Museum, Greenwich, London, SE10 9NF, U.K. Tel: 44(0)20 8858 4422. Fax: 44(0)20 8312 6632. URL: www.nmm.ac.uk

These will be "as fitted" builders drawings with no help to the modelmaker whatsoever. You will have to do a lot of sorting before you start. However, John Roberts has produced a very fine two-sheet set of *Victoria* which I used instead of the originals. Order it from Sambrook Maritime Models, 214 Ruxley Lane, West Ewell, Surrey, KT19 9EZ, U.K. Tel: 44(0)20 8391 5144. Fax: 44(0)20 8397 6430. E-mail: sambrook@dial.pipex.com. URL: www.sambrookmaritime.com

Chapter Two

The Hull

Duilio's hull was typical of battleships of the time – very heavy amidships with fairly blunt lines fore and aft. **Fig. 2-1** is *Empress of India's* hull. One practice, not seen now, was to enclose the propeller shafts in a conical casing down to what we would call the "A" frame. This period also saw the hull sides cluttered with gash chutes, heads (latrines), and other gear usually protected by massive timber deflectors.

After deciding to build the model to a scale of 1:100, I could start on the main piece – the hull. I have always had a bias toward carving rather than plank on frame; it makes a nice solid hull. You can do things to a carved hull without fear or favour, no chance of planks opening up, distortion, or what have you. It might even survive the modeller's nightmare of dropping the model. All my early models were hacked out of solid blocks with no machinery in sight, an experience likely to scar even the bravest soul. I have the scars still! **Fig. 2-2** shows *Devastation* at an early stage before adding the vertical hull sides including the armoured belt.

Bread-and-butter or lift system

Nowadays instead of solid blocks, we usually use the bread-and-butter system (**Fig. 2-3**), which is a stupid term. I much prefer the American "lift system" to which I shall adhere in the following dissertation. If ordering new material, you have a choice of lime (basswood), jelutong, or American yellow pine – these perhaps are the favourites. The best is the last, but it is expensive and difficult to find. Lime carves well, but is harder than jelutong. A Malaysian timber and relative of the rubber tree, jelutong has become the standard wood for (casting) pattern makers, supplanting American yellow pine. Although a most uninteresting wood from the visual point of view, it can be obtained in large, knot-free pieces. In fact, I have seen only one knot in all the years I have used it, and that was easily consigned

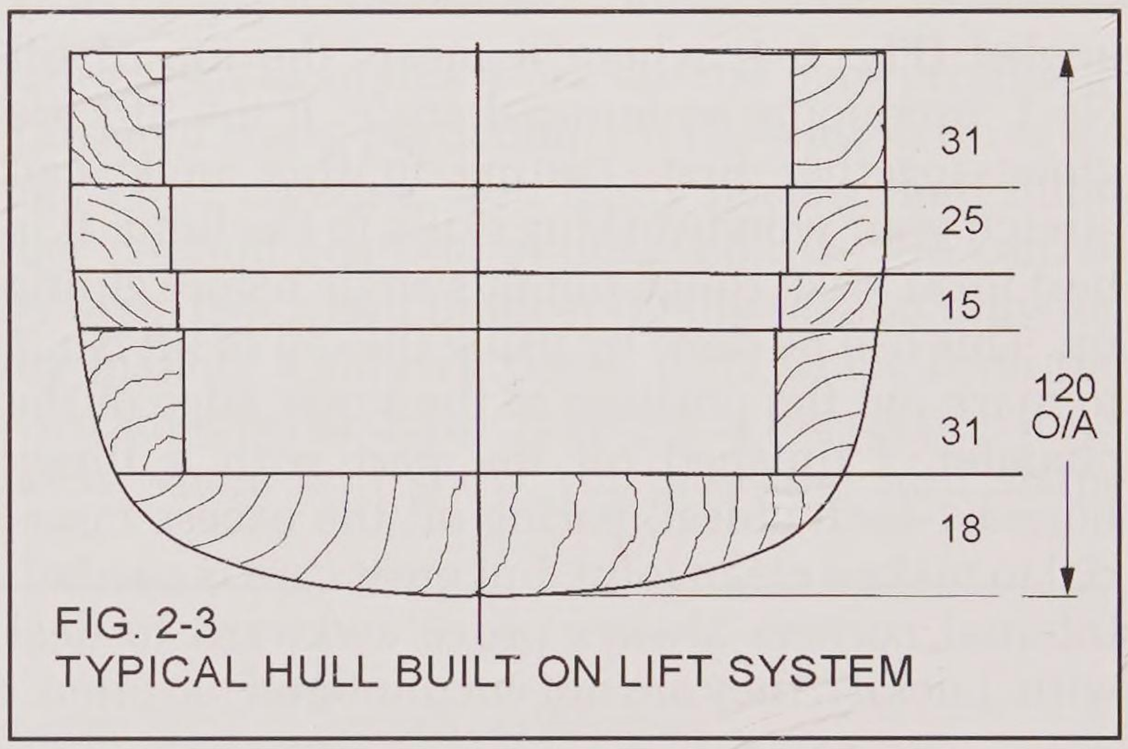
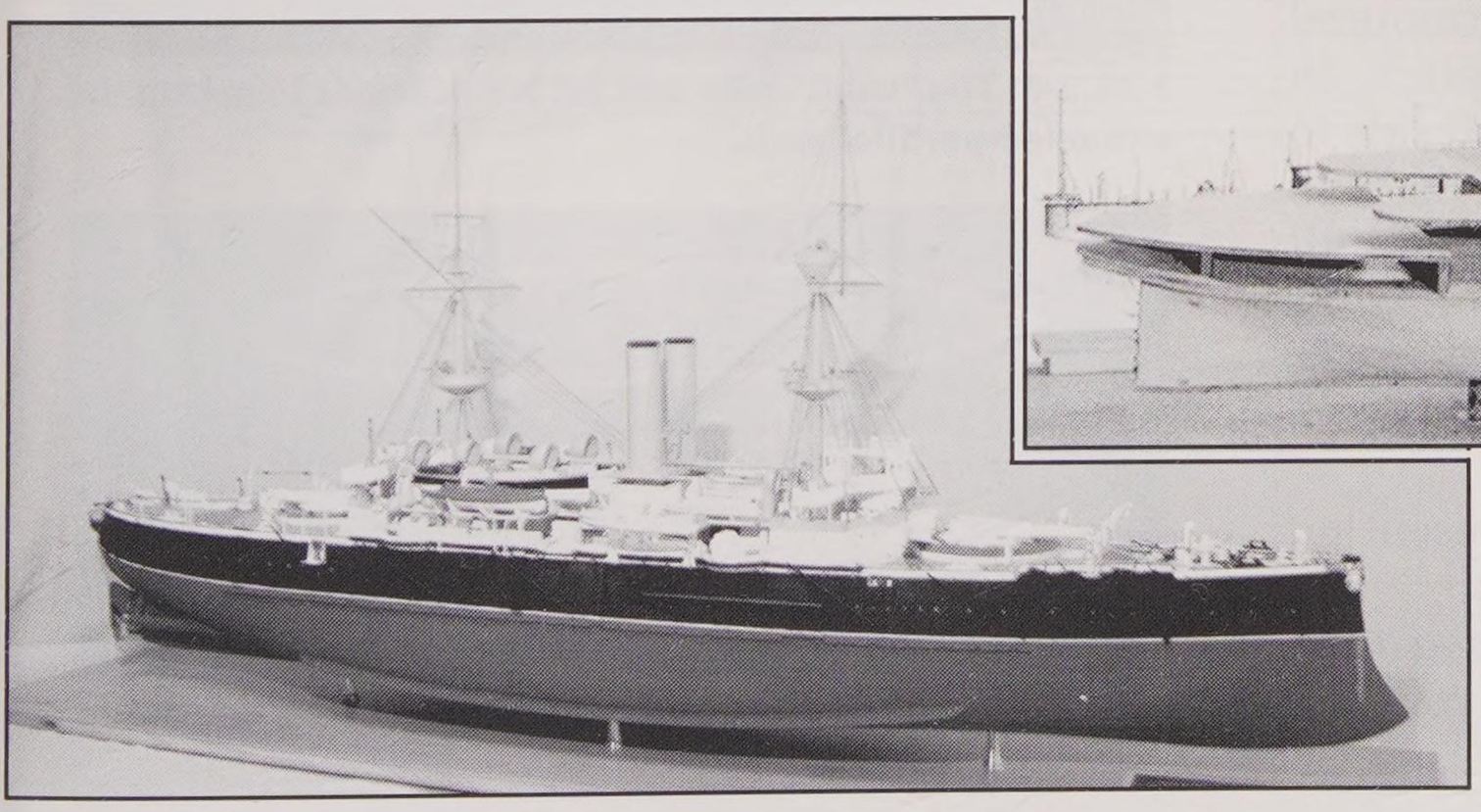


FIG. 2-3
TYPICAL HULL BUILT ON LIFT SYSTEM



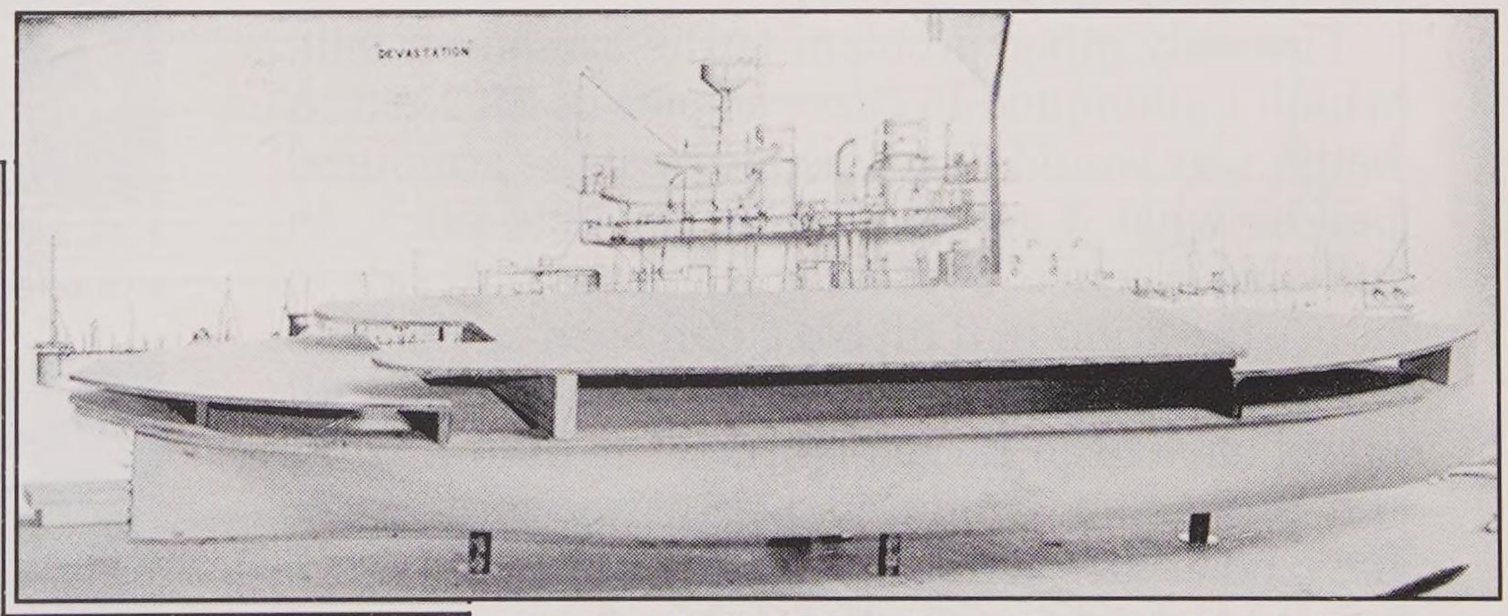


FIG. 2-1 (left): Side view of a typical hull from this period. FIG. 2-2 (above): *Devastation's* hull before adding the vertical hull sides including the armoured belt.

to the waste by careful cutting. Jelutong has a minor problem in that it has resin ducts in places, but these can be easily filled with Isopon (polyester paste used in repairing cars) or any convenient filler. The ducts are usually about 10mm x 2mm in size and contain a dried up piece of resin that one can easily pick out.

Selection of waterlines

The next requirement is to select the thickness of the lifts. If the line drawing has a series of waterlines, the lift thickness can be made to suit. Sometimes a feature of the hull, such as an armoured belt or torpedo bulge, will dictate the position of some of the lifts. Try to visualise carving problems when selecting your lift positions. If the contour changes sharply, it is usually best to site a joint at this point. Concave contours can be much more difficult to manage than convex.

In the case of *Duilio*, the second lift is sharply angled (**Fig. 2-4**) where it meets the top of lift No.1, producing an internal angle. If the lifts are glued together first, cutting in this angle can stretch your woodworking skills to the limit. It is best to, at least, rough out this angle before gluing up. This can be done by using the top of lift No. 1 to mark out the position of the lower edge of the chamfer. I finished off the part with a finely honed 1-inch chisel, paring off the excess material to make a clean joint, but great care is needed. Internal corners always prove awkward to deal with. Luckily, they are not encountered too often.

Armoured belt

The only other problem is the armoured belt, which I attempted to carve as part of lift No.3. A better way would have been to treat the armoured belt as what it actually is – a separate piece. In full-size practice, a recess is left in the hull side to house the armour. If lift No.3 had been cut back to form a pocket, the fore and aft ends of the hull could have been carved without the hindrance of the projecting armoured belt. This could then have been inserted as a separate strip afterward. Is not hindsight a wonderful thing?

Otherwise, the hull carving should present no difficulties if you remember these points:

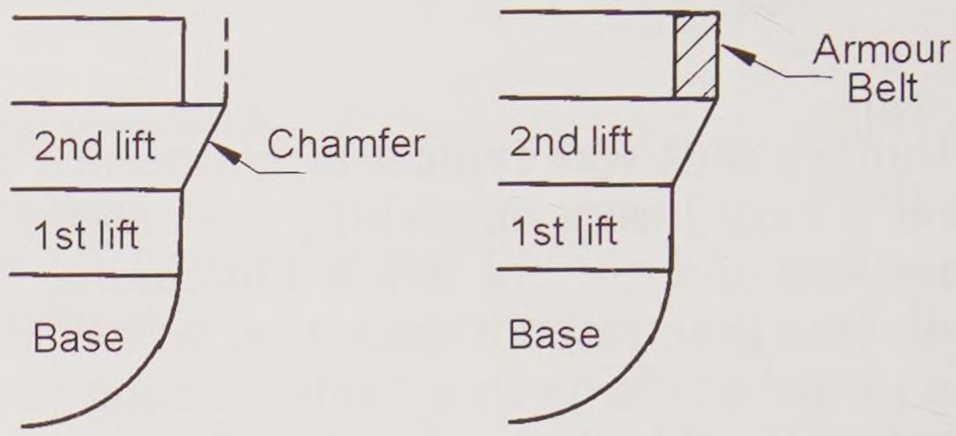
1) Control registration of the lifts with *wood* dowels. If you use metal, sooner or later you will find them in the way of your drill bit.

2) Watch the beam dimensions of the lifts, which become somewhat flexible once their interiors are removed. Removing the lift's central area not only lightens the hull, but also allows the structure to contract if it wants to, which will avoid cracking. For working models, it is essential of course.

3) When commencing gluing, clamp the base and No. 1 lift to a known flat surface to avoid glued-in distortion, wind (twisting), or hogging. **Fig. 2-5** shows lifts No. 1 and 2.

4) Before gluing, clean out any wood dust between lifts after drilling dowel holes. **Fig. 2-6** shows the lifts glued up, and **Fig. 2-7** shows band sawing the sheer on the top lift.

FIG. 2-4
ARMOURED BELT POSITION AND DIFFICULT INTERNAL ANGLE



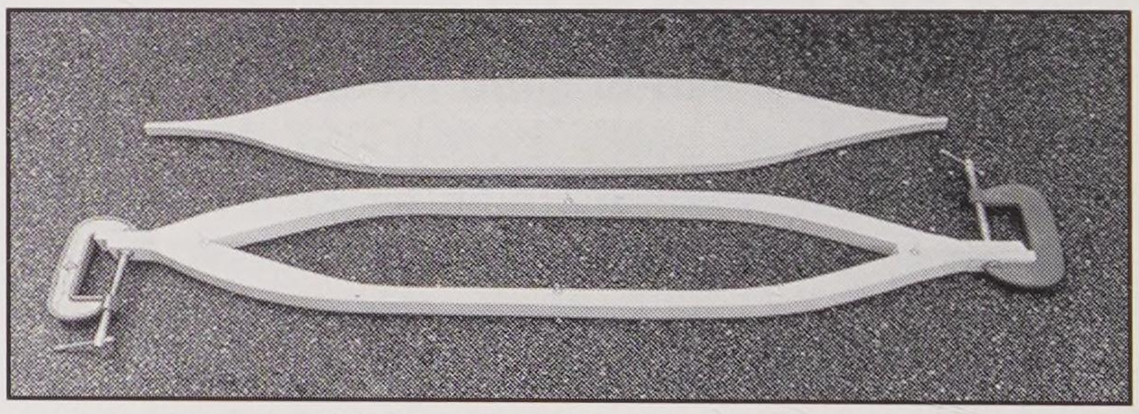


FIG. 2-5: The "solid" base and lift No. 1. Note clamps on the extended parallel ends.

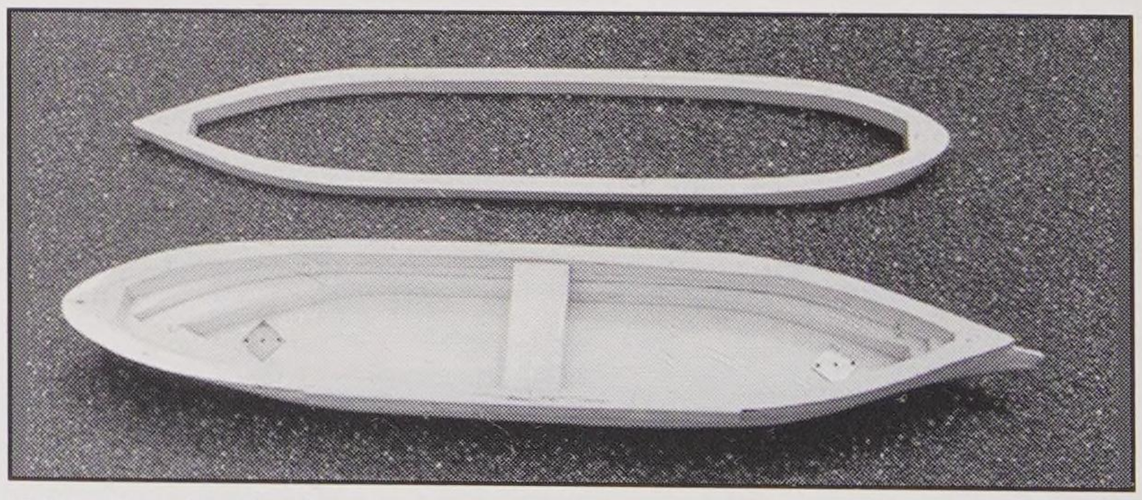


FIG. 2-6: Hull glued up.

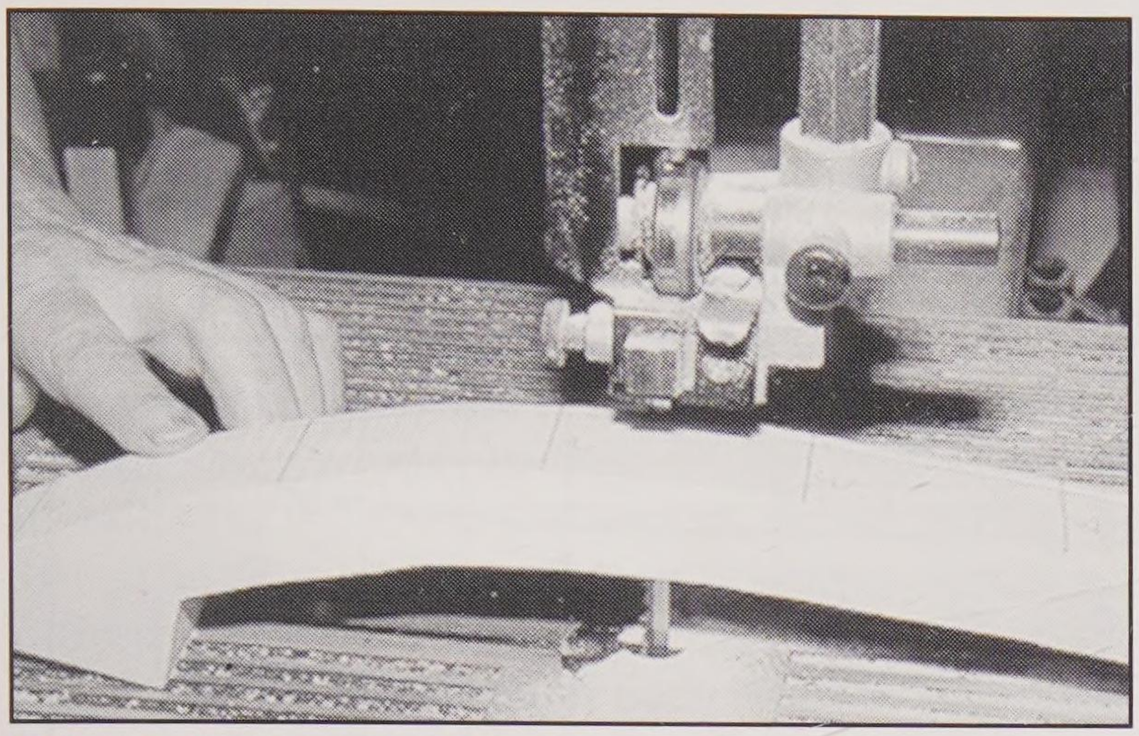


FIG. 2-7. Band sawing the sheer on the top lift.

Changing waterlines

Fig. 2-8 shows typical transverse sections and waterlines. If you decide that the waterlines as drawn are not in the position you want, or if they do not exist, they can be constructed from the transverse section drawing. If a horizontal line is drawn on the section at the height you want, the dimensions from the vertical centreline to the hull side at every station can be measured off and plotted on the plan. A free curve can then be drawn through these points to create a new waterline. The sheer (side elevation) will give you the intersecting points at the bow and stern. These can be projected down onto the plan. The

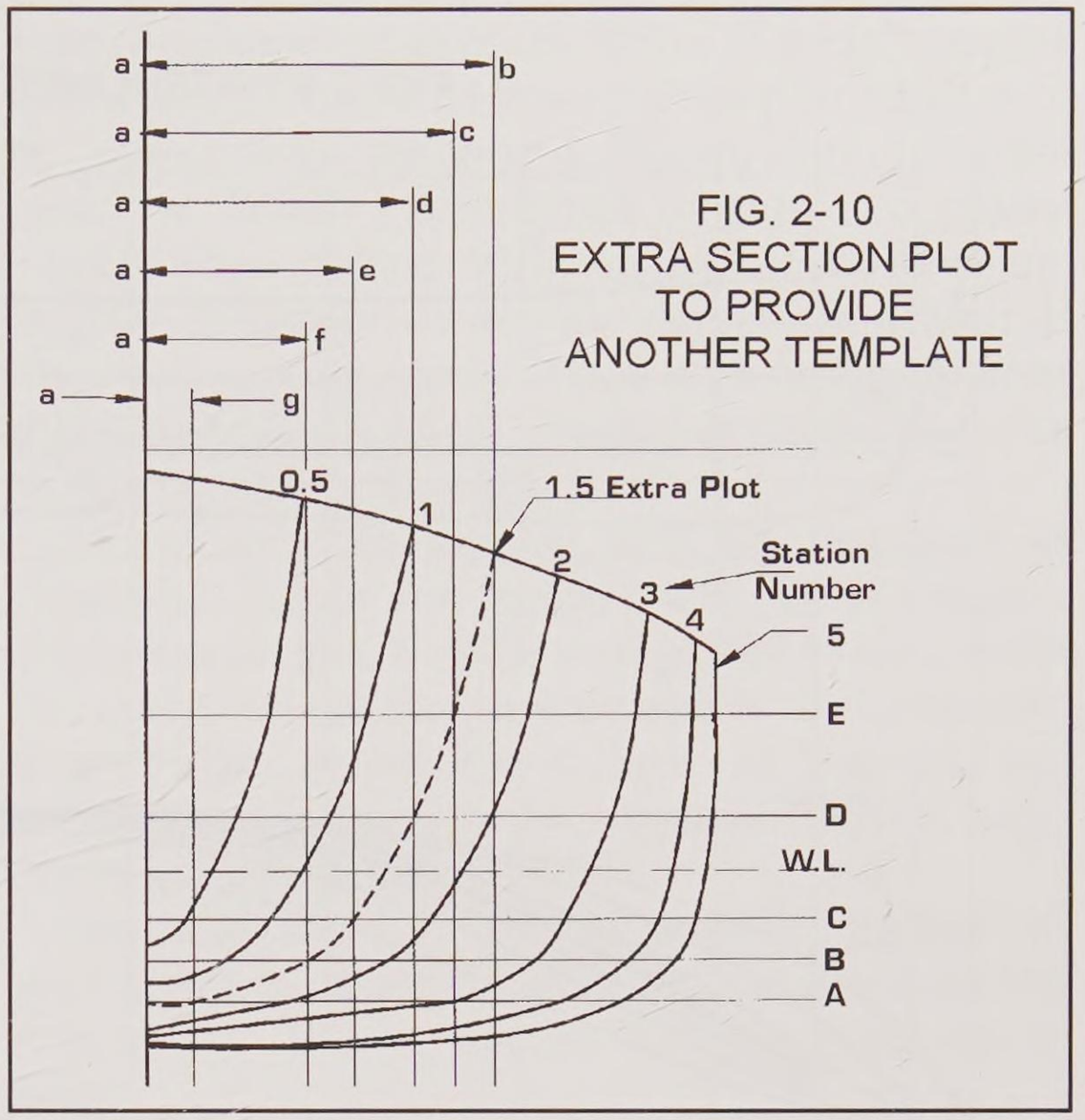


FIG. 2-10
EXTRA SECTION PLOT
TO PROVIDE
ANOTHER TEMPLATE

critical areas in this work are the plan profiles at bow and stern, particularly if the station lines are not close together. You really need a "half number" station position at these points. You can, of course, plot a half number on the section drawing by making a shrewd guess at its shape from the two adjacent sections. Looking at the section lines as a whole will show you how the hull shape

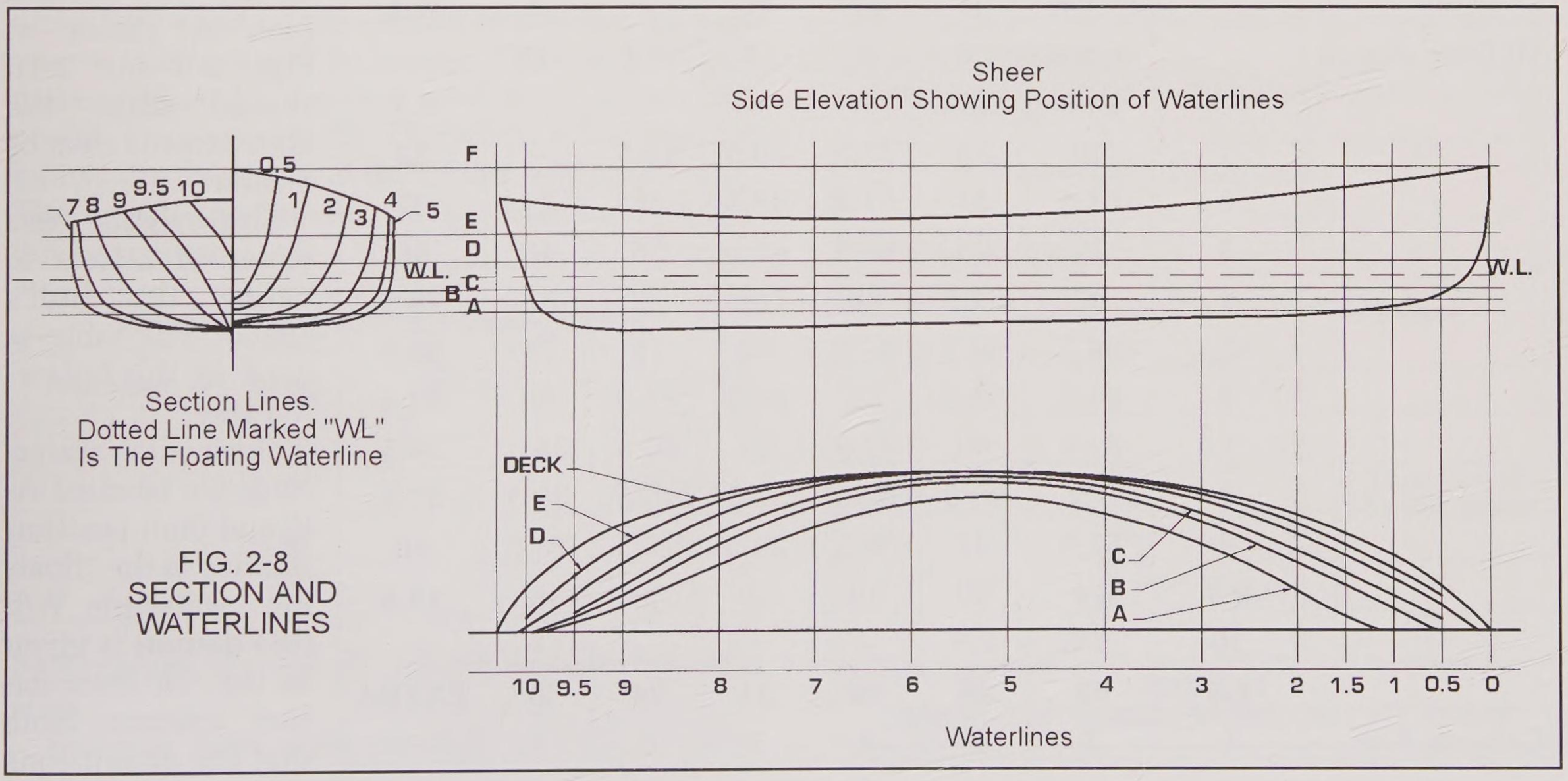


FIG. 2-8
SECTION AND
WATERLINES

FIG. 2-9 WATERLINES INDICATING THE EXTRA PLOT

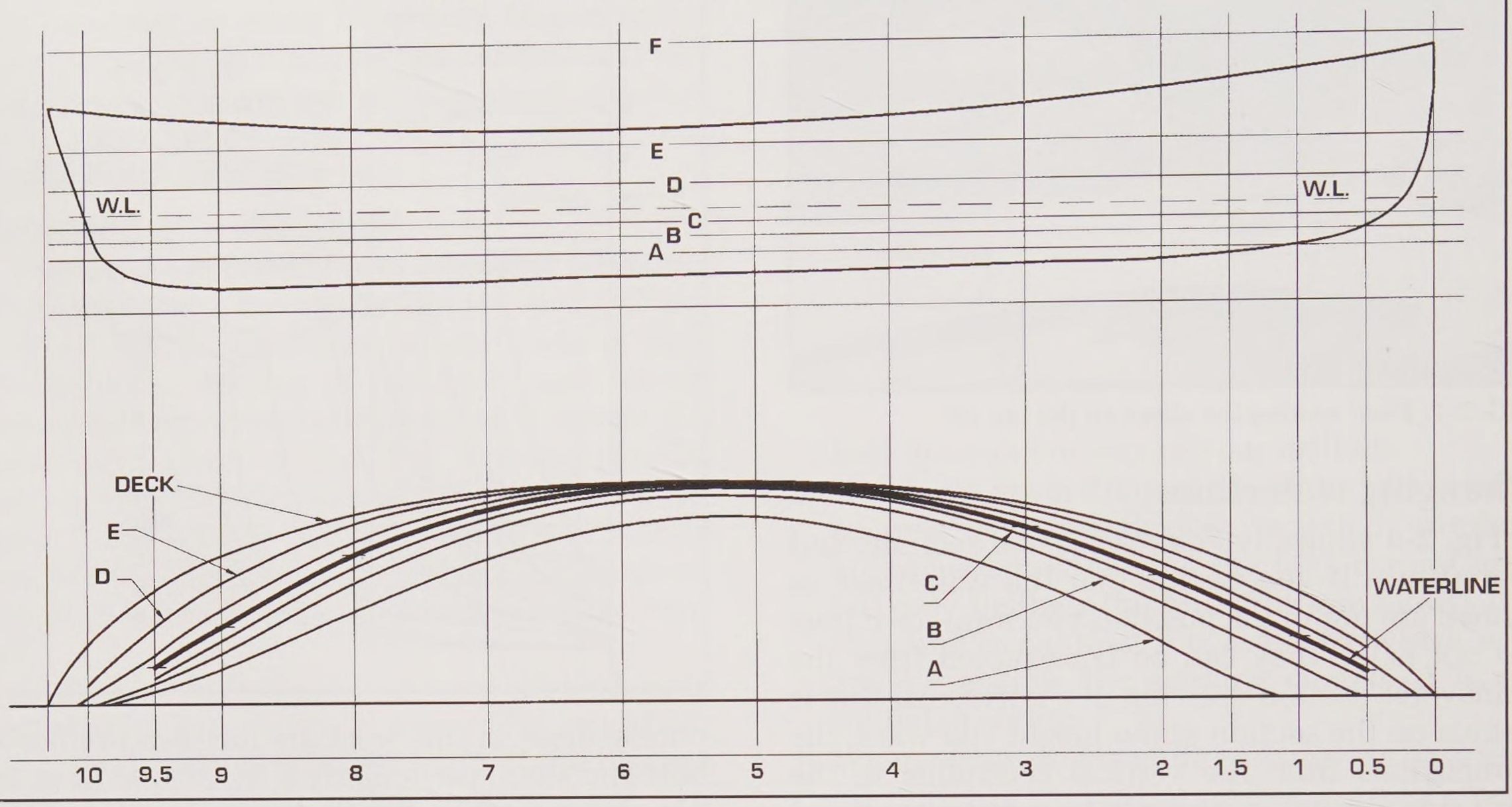


Table of Offsets for the Transverse Sections and Waterlines Shown in FIGS. 2-9 and 2-10

	Station No.	Waterlines						
		DECK	E	D	C	B	A	**W/L**
Ht from datum		varies	23	8	-7	-13	-19	
	0.5	23.5	18.5	13.5	6	–	–	**9.7**
	1	40	33	27.5	18.5	11.5	–	**23**
	2	61.5	57	51.5	42.5	36	21	**47**
	3	75	73	69.5	62.5	58	46	**66**
	4	82	81.5	80	76.5	72	62	**78.5**
	5	84.5	84.5	84.5	82	79	71	**83.5**
	6	84.5	84.5	84	80.5	77.5	68	**82.5**
	7	81.5	80	77.5	71	66.5	55.5	**74.5**
	8	73	69.5	62.5	52.5	46.5	35.5	**57.5**
	9	57.5	47	36.5	24.5	19.5	13.5	**30**
	9.5	44	30	19	10	7.5	5	**14.5**
	10	23	7.5	–	–	–	–	–
	1.5	**52**	**46**	**40**	**31**	**24**	**8**	**EXTRA**
Column Nos.	1	2	3	4	5	6	7	

changes as it runs fore and aft from the mid section, and should give you a fair idea of the shape of any new section plot. A glance at **Figs. 2-9** and **2-10** should make the above words clear or clearer.

Shipwrights use tables of offsets to define the hull's shape. The table is used in the following way:

Horizontal waterlines are labelled A-E, and their position relative to the "floating" waterline W/L (the datum) is given in the "Ht from datum" column. Note that the dimensions

above the W/L are positive and those below are negative. The half-width of the vessel measured from the vertical centreline is shown for every station along the hull. Taking station 5 as an example, the half-hull width is given as 84.5 at waterline E, and 79 at waterline B.

If an extra waterline is required owing to plank thickness or whatever, then a new waterline can be constructed from the section drawing (**Fig. 2-10**). If a new horizontal line is drawn at the required height on this drawing, then the half-widths can be taken off at each station. These figures can then be replotted on the plan waterline drawing and a fair curve drawn through them. **Fig. 2-9** shows a plot of the floating waterline derived in this way. This is a safer way than merely drawing a fair curve between the two adjacent waterlines and hoping it will be correct.

The section drawing, **Fig. 2-10**, shows an extra station plot at 1.5, which can be used to make an extra template if required. The hull profile varies little amidships, but the extreme ends, particularly the stern, can be difficult.

Ordering and preparing timber

When ordering the wood, if you get it prepared, make sure the sawyer knows the importance of the thickness dimension. If, for instance, he planes all the lifts 1mm too thin (it has happened) then, if the stack comprises six pieces, it will be 6mm (¼") short of the correct dimension and all your waterlines will be wrong. This error will be more evident at the bow and stern where the profile changes rapidly. Therefore, make sure he knows the thickness of the lifts is very important. The length and breadth of the boards is usually not so critical.

Wood Cutting List for *Duilio's* Hull

Number	Length	Width	Thickness
1	44"	7"	18mm
4	44"	4"	31mm
2	44"	4"	15mm
2	44"	4"	25mm

PAR (planed all round) – all dimensions finished sizes

You may have other sawmill problems. Make sure the planed edge of the board is at right angles to the faces. I had a case where the planed edge of the pieces were not so and, like an idiot, I did not check it. When I attempted to glue two pieces edge to edge to make a lift, instead of the faces being flat, they took on several degrees of dihedral! How you can get errors of this type using a planer is beyond me. I suspect, instead of using the fence on his machine, he did it freehand.

The other problem can best be described as "chatter." When the boards are put through a thickness planer, there is a stage just as they enter the cutter where they are unstable, and you tend to get ridges across the surface. At least the upstanding ones need to be removed with a hand plane before gluing.

One other thing. If you buy prepared timber, expect to pay as much for the preparation as for the timber, but it does save an enormous amount of time.

Lofting

Transferring the shape from the plans can be done in a number of ways. Pricking through or using carbon paper are two. If you use two pieces of carbon paper back to back, you will not only transfer the profile onto the wood surface, but also onto the back of the plan. This is extremely useful when you turn over the plan to do the other half (assuming you only have a half plan). The double carbon paper trick is not necessary for the second plotting.

The most important thing to remember when

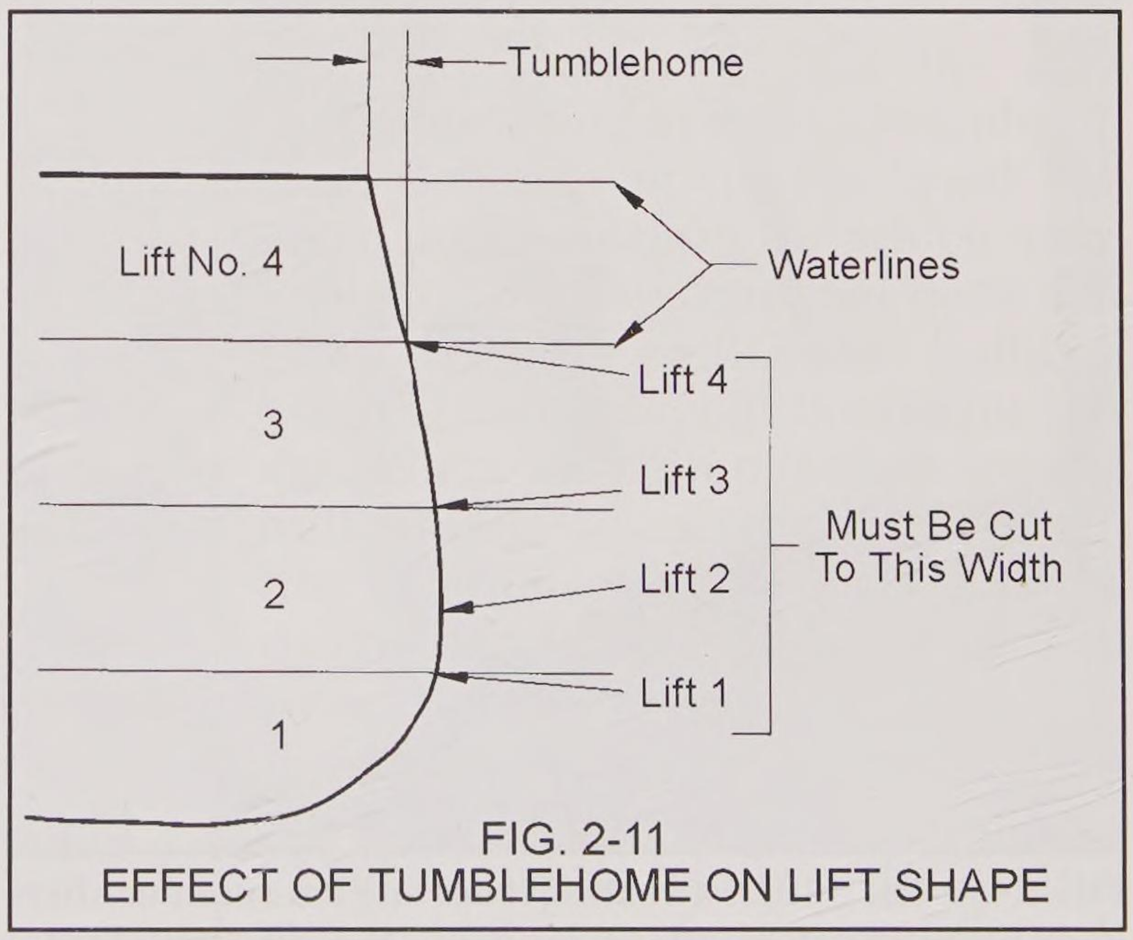


FIG. 2-11
EFFECT OF TUMBLEHOME ON LIFT SHAPE

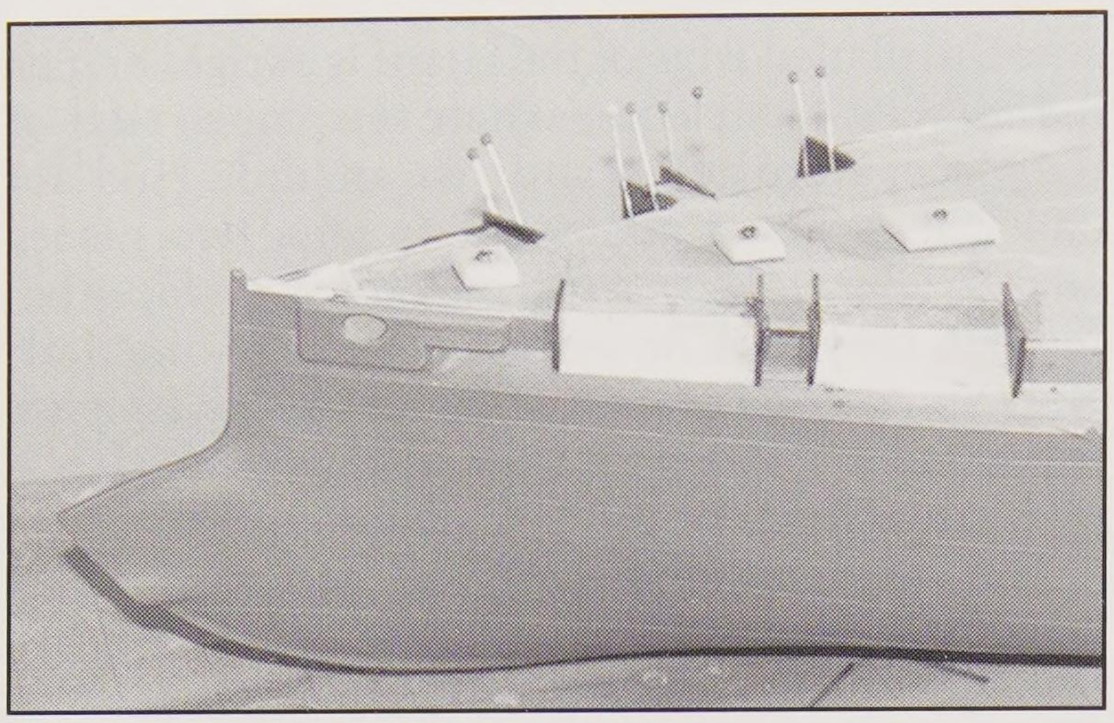


FIG. 2-12: Lining out the anchor beds.

cutting lift profiles is that the width at any point must be a maximum (**Fig. 2-11**). Let me explain. If the hull section is one where the maximum beam is at the top and the profile tapers down to the bilges, the maximum material will lie at the top of every lift and no problem exists. If, however, the section has tumblehome, a torpedo bulge, protruding armoured belt, or whatever, this happy state does not exist, as some lifts in some places must be wider on their bottom face than on their top. Cutting such lifts to their top waterlines will leave you short of material, which can be extremely frustrating. It is best to spend some time checking this to avoid wasting valuable wood. Even on simple, uncomplicated hulls, a canoe stern can lead you into trouble if you use only top waterlines, because a degree of tumblehome exists in the stern.

Because *Duilio's* bow houses four sloping anchor beds, this area must be left solid. **Fig. 2-12** shows the anchor beds being lined with 1/16" Bakelite sheet, which enables a much cleaner paint job rather than trying to fill and paint end grain wood. I used Bakelite because it was available, but any suitable plastic sheet would suffice.

Carving the hull

Carving the hull requires a set of half section profiles, which I cut from card. Others make them from metal – a shocking waste of material and time in my book.

Start carving amidships and continue to bow and stern, which usually are the more difficult areas. Do not attempt to attain the final shape at once, but remove material along a length getting gradually closer to the final form. **Figs. 2-13** and **2-14** show the use of a Surform file on the bow area. The glove protects my damaged left hand, but also protects the knuckles. **Fig. 2-15** (c/s) shows the rough out coming close to finality. At this point, start to work toward a smoother finish. It is a good idea to make card templates of the bow

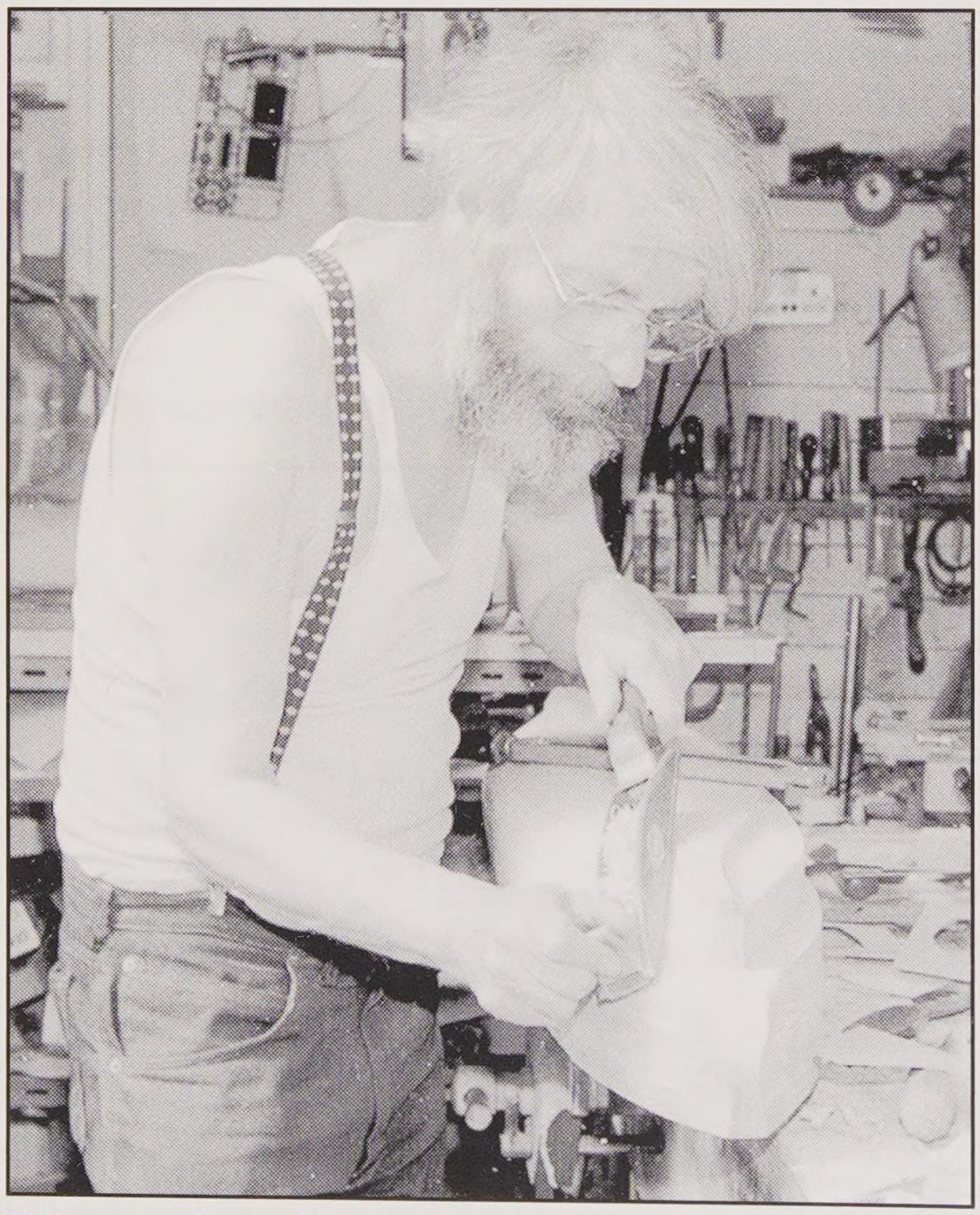


FIG. 2-14: The author sweating it out one hot summer afternoon using a Surform file on probably *Magnificent's* hull.

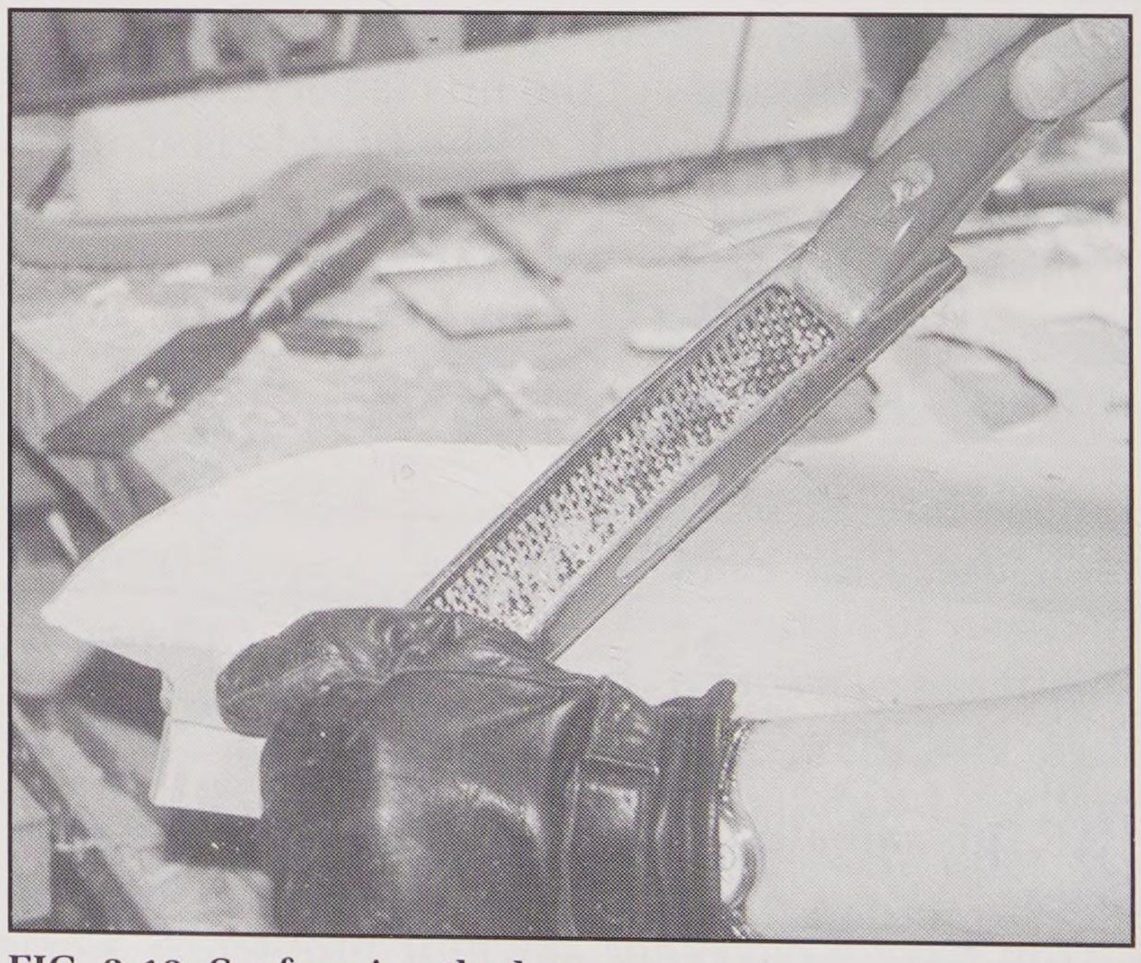


FIG. 2-13: Surforming the bow area.

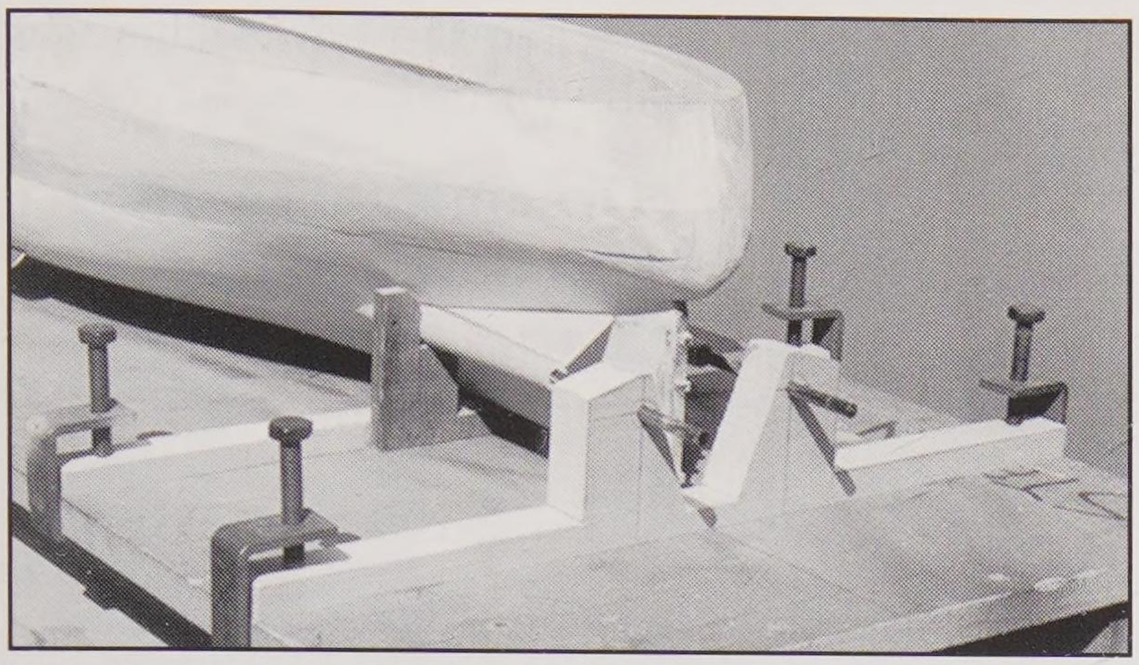


FIG. 2-16: Fixture for aligning the propeller shaft.

and stern profiles as well.

However, if you can tackle a complicated model of this type, you should not require any real help in carving the hull. If you do, *Advanced Ship Modelling* (*ASM*) contains a detailed description.

Propeller shafts

ASM also details how to fix the propeller shafts (**Fig. 2-16**). Being a Victorian era battleship, propeller shafts were enclosed in tapered conical propeller tunnels made of gun metal (unlike modern warships where the propeller shaft between the hull exit and the "A" bracket is open). These propeller tunnels were turned from wood. A triangular wooden web about 3mm thick connects the tunnel with the hull, which effectively dispenses with the need for an "A" frame. **Fig. 2-17** shows the propeller shaft casing.

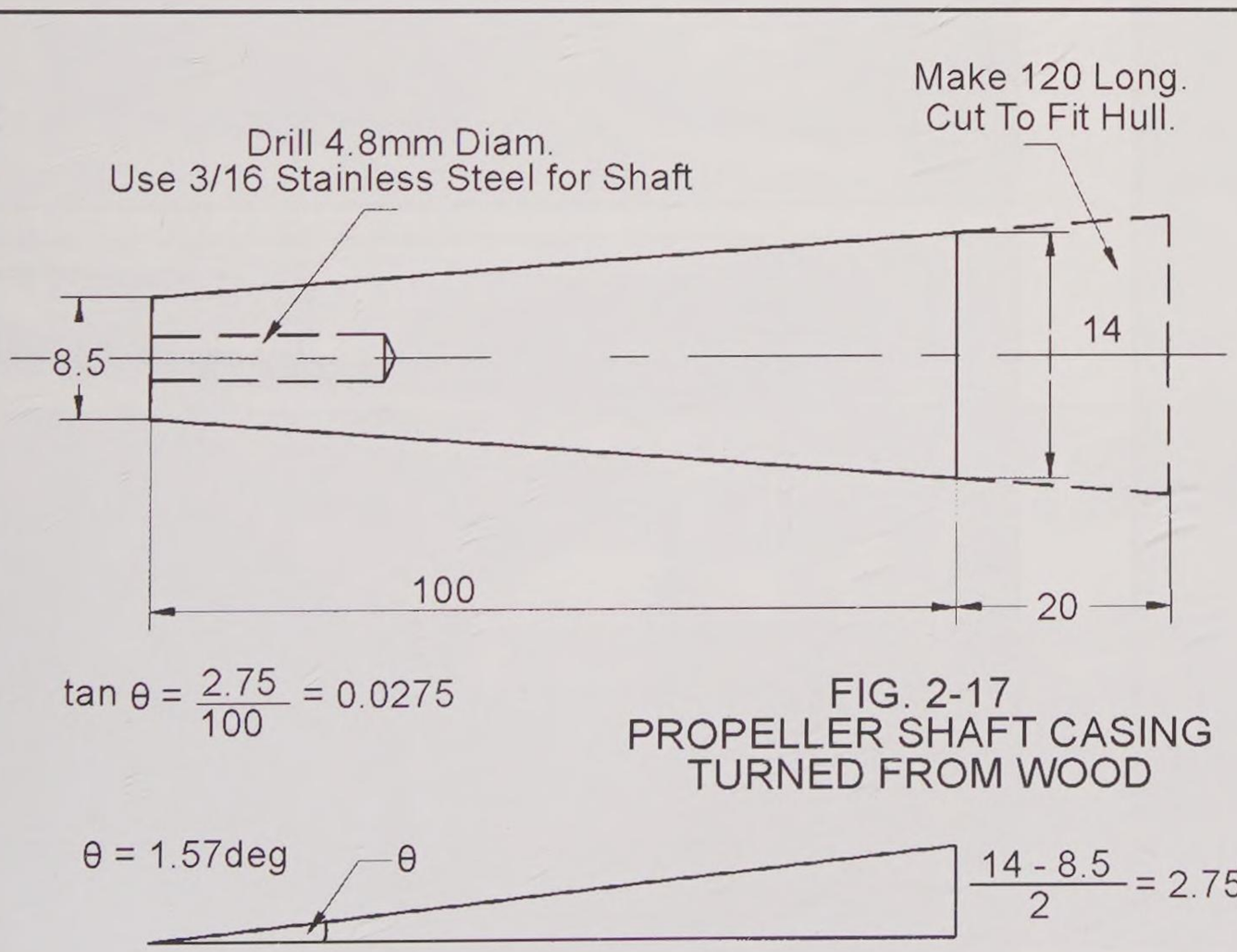
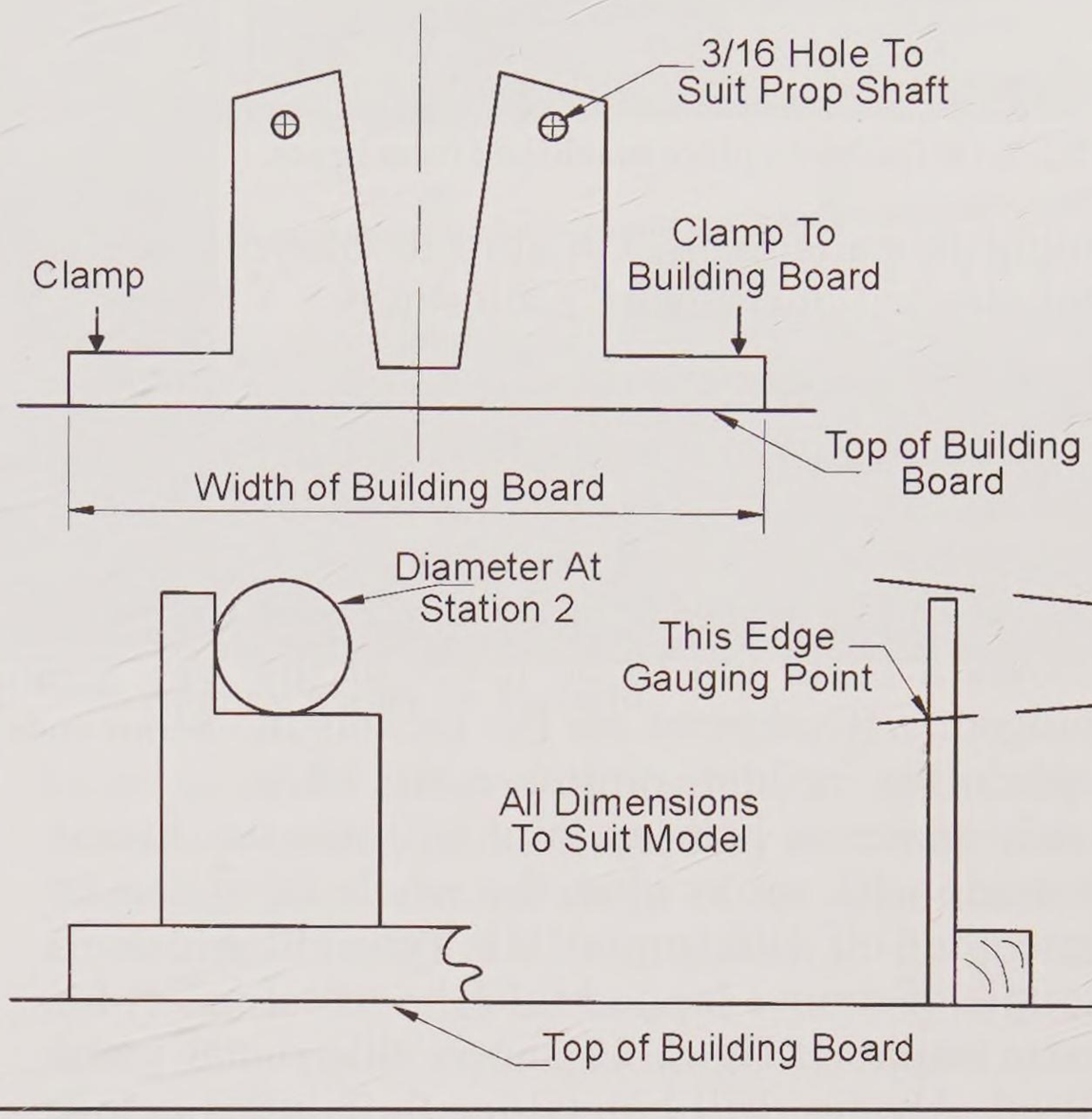


FIG. 2-17
PROPELLER SHAFT CASING
TURNED FROM WOOD

FIG. 2-18: PROP SHAFT ALIGNMENT FIXTURE



A fixture was constructed (**Fig. 2-18**) to align the whole assembly. It consists of two transverse members temporarily clamped to the building board. The fore one supports the fore end of the propeller tunnels and the aft one the propeller shafts. In theory, this should have produced the perfect job. Indeed, it looked as if it had. It was only when I tried to fit the propellers that I found the starboard one fouled the deadwood (keel). Joy of joys – this occurred after the anti-fouling painting had been completed. "The Governor of the Dockyard" ordered an investigation, which concluded that the fixture had been correctly aligned with the building board's centreline, but the model had not. When setting up, I assumed the hull was already in the correct position. The effect of this was that the deadwood did not lie centrally between the shafts, so the port propeller fitted with plenty of clearance, but the starboard one ...!

I tell this tale to reinforce the fact that you cannot over-check dimensions. It

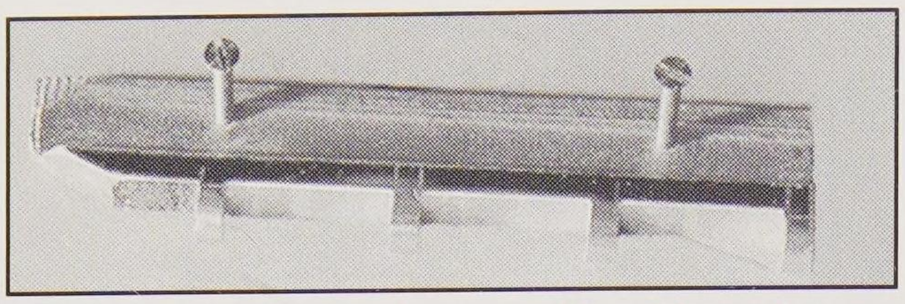


FIG. 2-19: Gudgeon piece machined from brass.

might be called the "I'm sure its okay, but check it once again" philosophy.

Rudder gudgeon

Besides the propeller shafts, the stern houses the rudder. This was catered for by gluing in the machined brass piece shown in **Fig. 2-19**. Using a metal insert allows a clean job to be made of the gudgeons. (Gudgeons are the sockets in which the rudder pintles turn). If a fairly generous half lap joint with the deadwood is made with epoxy glue, the whole thing can be smoothed off with Isopon. It is a good idea to use a couple of screws tapped into the metal insert for extra support. **Fig. 2-20** shows this metal piece fitted. Always drill hole(s) for the pintles before attaching the metal to the wood. Otherwise, boring holes may be impossible.

The final carving job is to form the rebate on the top surface for the false deck, but more of this when detailing the deck.

Fig. 2-21 shows the foundation for the bow torpedo tube. This was later smoothed in with Isopon when the bow shape was finally formed.

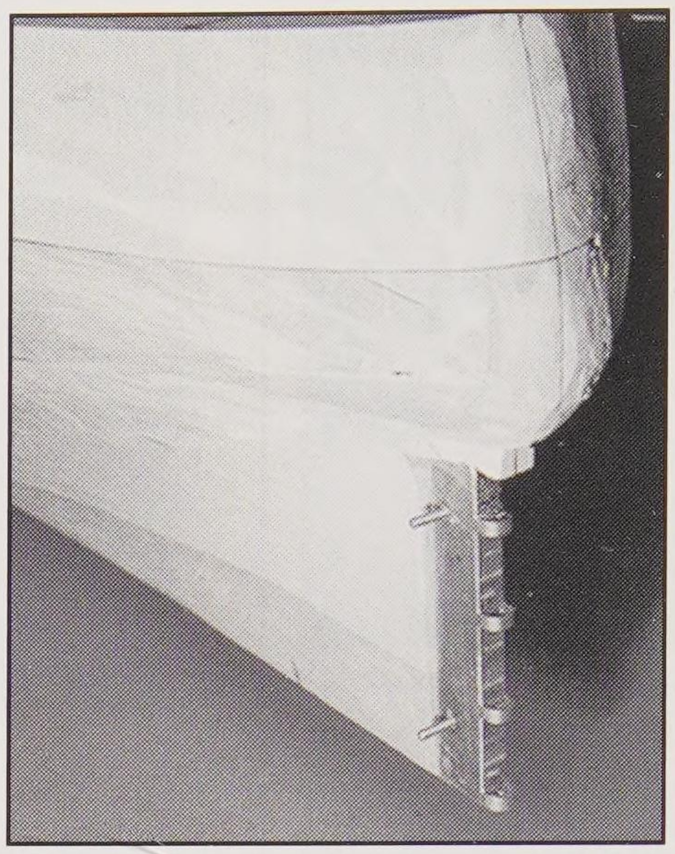
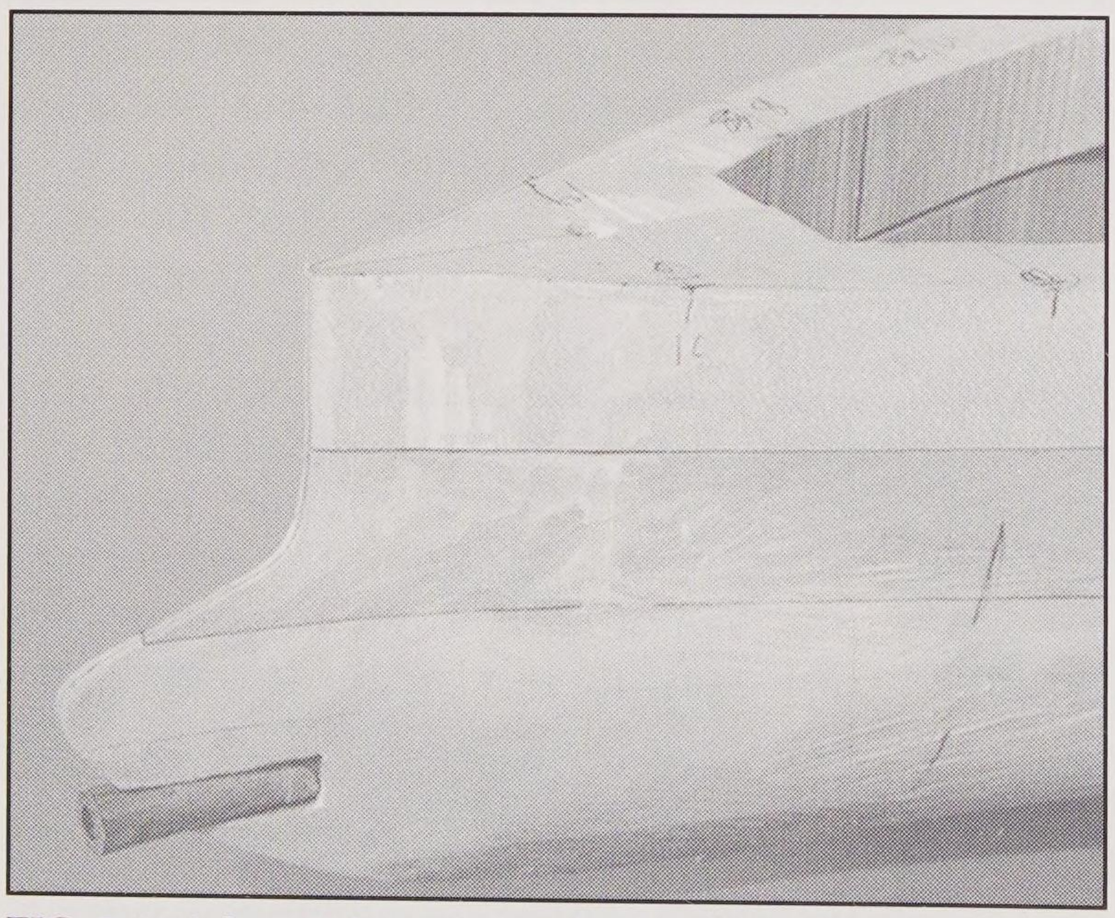


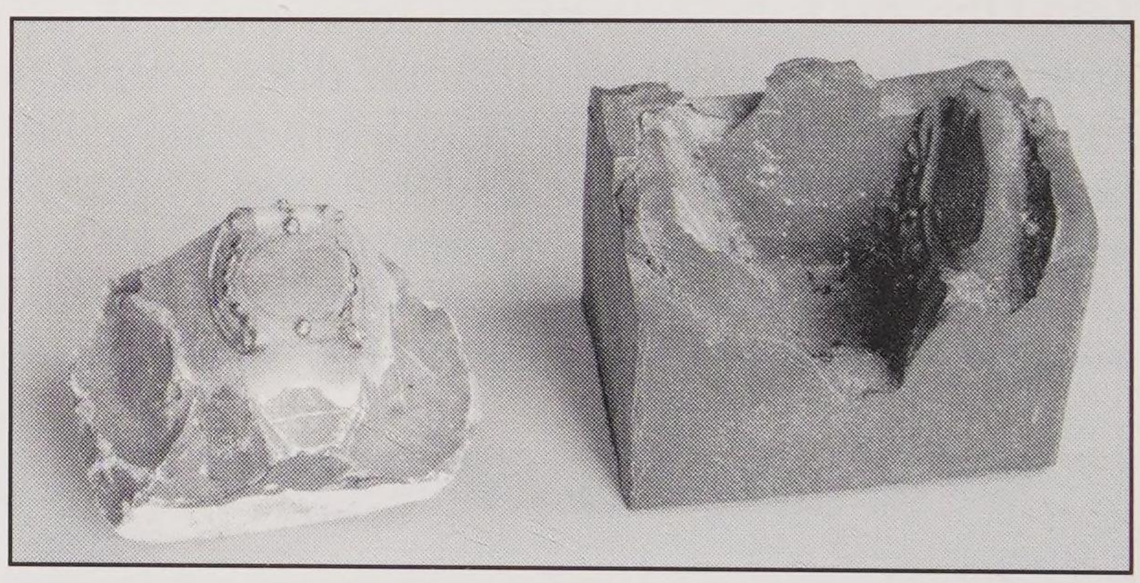
FIG. 2-20: Gudgeon piece fitted. Screw ends will be cut off.

Ornamental carving at bow and stern

This relic of sailing ship practice carried on into the Victorian navy and into the period under discussion, but by the time of *Magnificent* (1894), it had entirely disappeared. The other three ships I modelled had varying degrees of carving at least on the bow. *Victoria's* carved bow work was quite extensive (**Fig. 2-22** c/s).

To simulate this carving, a plaster of Paris cast was made of the bow area on which the carving was made up in dental wax. An impression of this was made and a casting produced which was glued to the hull. The left-hand image in **Fig. 2-23** is the dental wax master (note the metal studs representing balls round the shield), and the right hand is a moulding of this





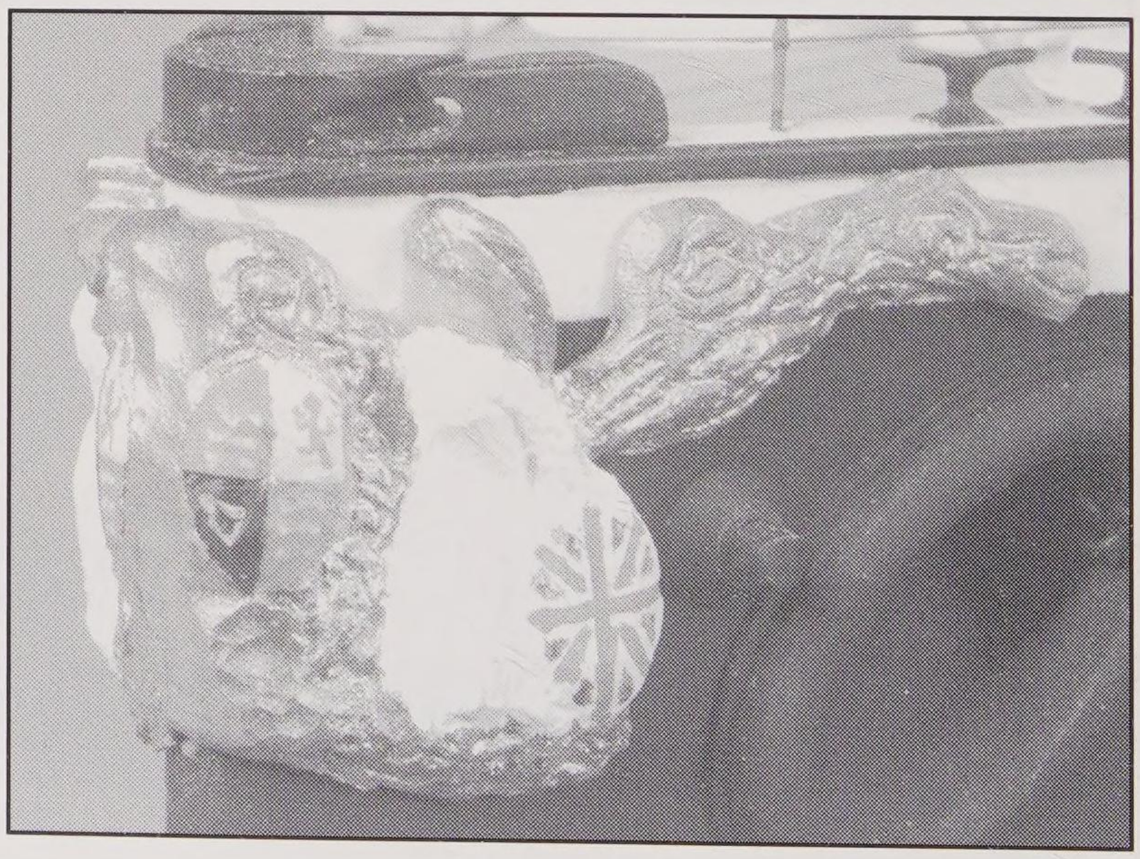


FIG. 2-21 (above): Foundation for bow torpedo tube, which will be smoothed in with Isopon later. FIG. 2-23 (center right): Master and mould for *Victoria's* bow. FIG. 2-24 (bottom right): *Empress of India's* carved and painted bow.

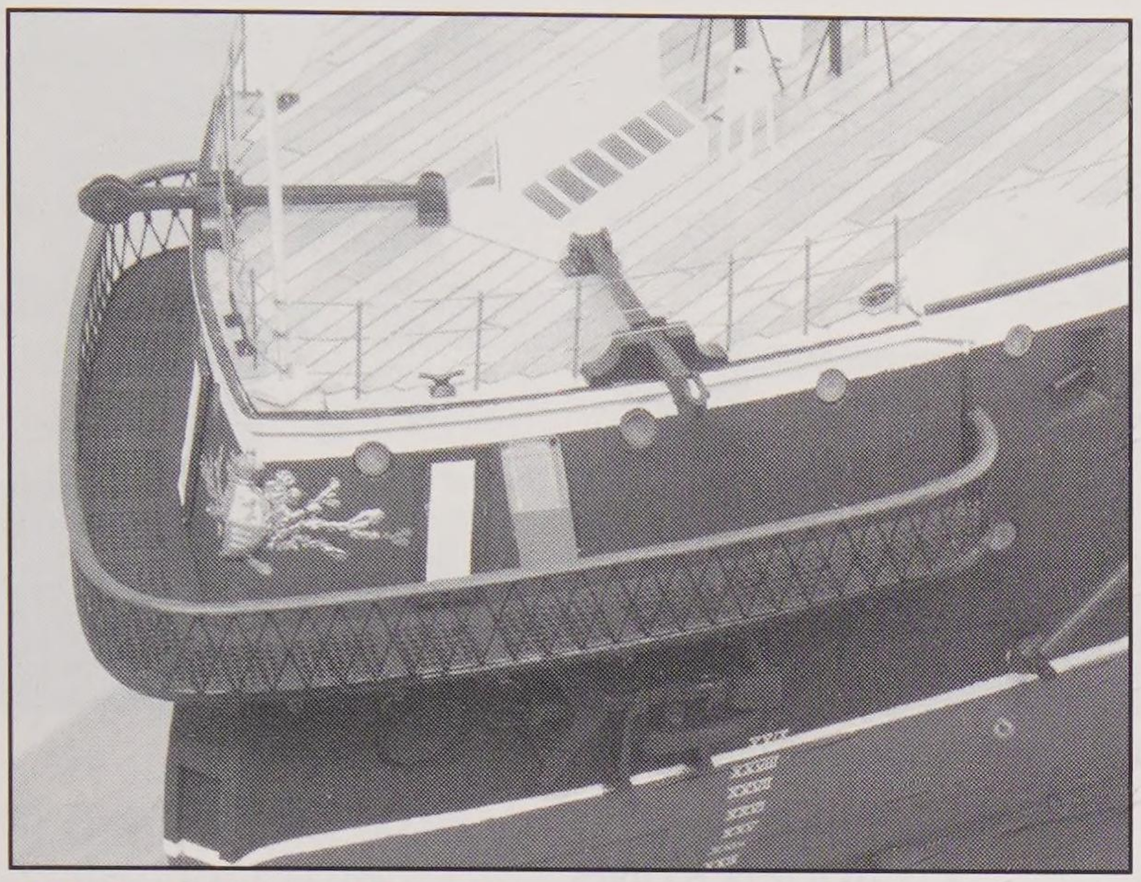


FIG. 2-25: Admiral's walk on *Empress of India*.

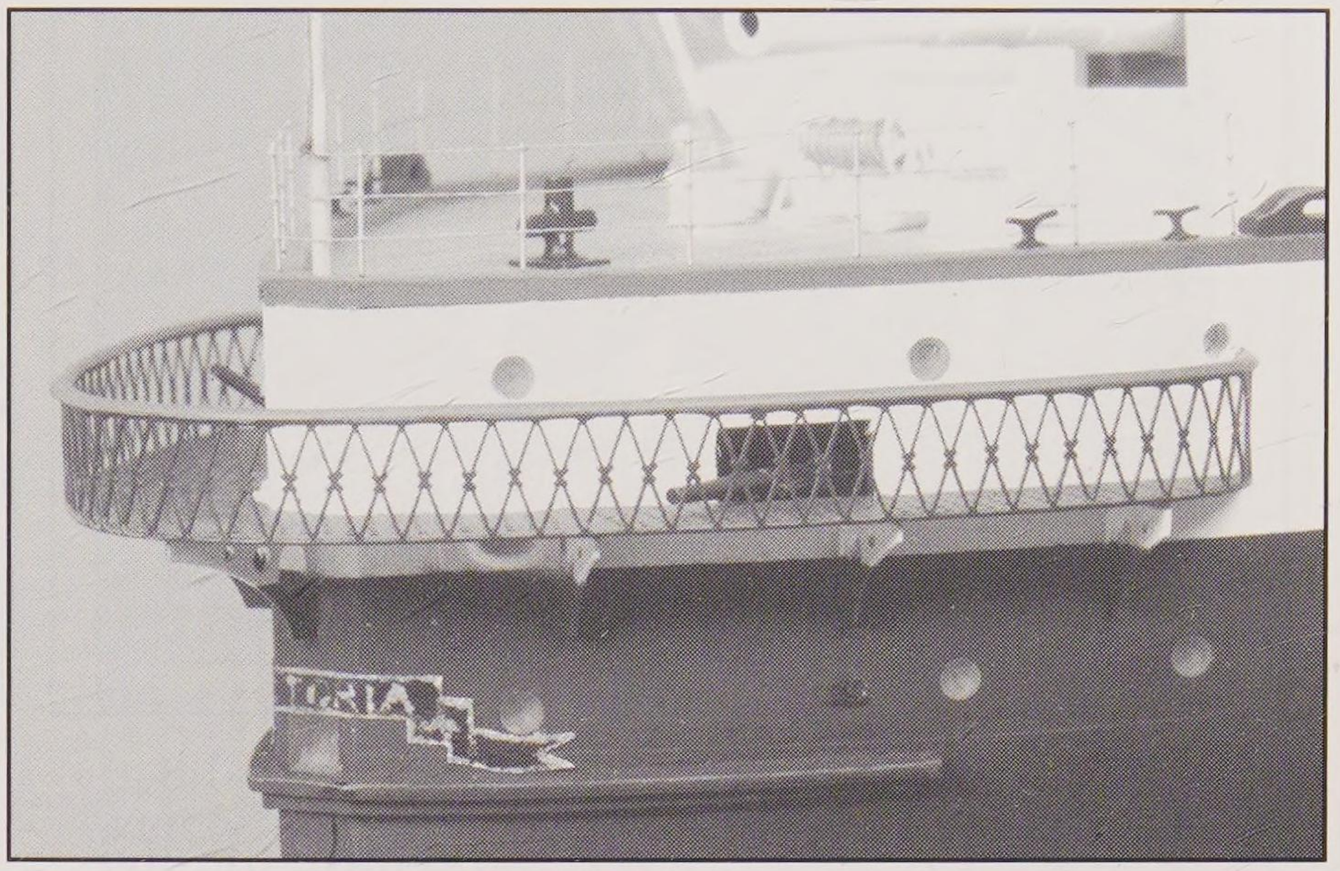


FIG. 2-26: Admiral's walk on *Victoria*.

from which the appliquéd pieces were cast. The main feature was a shield carrying a coat of arms, presumably Queen Victoria's. This was painted on – quite a job! The rest of the carving was painted with gold paint.

Fig. 2-24 shows *Empress of India's* intricate bow carving and painting.

Admiral's walk

This consisted of a V-shaped extension to the stern to allow the Admiral, if carried, to exercise away from the ship's company. His day cabin was at the extreme stern, of course, and allowed easy access to his walk. **Fig. 2-25** shows the Admiral's walk on *Empress of India* and the stern decoration. By this time the decoration was becoming less elaborate and, in a few years, it disappeared altogether. **Fig. 2-26** shows the Admiral's walk on *Victoria*. Note it shows only the name on a ribbon with no other decoration.

The Admiral's walk comprised a V-shaped deck surrounding the stern. It was pierced with many holes to avoid the sea imposing any undue hydraulic pressure, and enclosed by an ornamental guardrail. Most capital ships of the time carried an Admiral's walk and continued to do so for many years, although some were removed in later refits. They make a nice feature to the model, particularly if well executed.

The guardrails for the walks on my models are etched in brass. This was the first use I made of the etching process.

Anti-torpedo booms and nets

With the ever-increasing use of the locomotive torpedo during this period, nets were thought of as the answer. They were hung from wood or steel booms controlled by a maze of cables. On many photos the rolled up torpedo net can be seen on the net shelf. The net consisted of interlocking rings like chain mail. They could only be successfully deployed with the ship stationary. Their usefulness disappeared with the advent of more powerful torpedoes and the net cutters attached to them. By the start of WWI, they had disappeared. Although *Duilio* had no nets, they make a nice modelling feature on the other ships. **Fig. 2-27** shows *Empress of India's* torpedo nets lying on a shelf at main deck level.

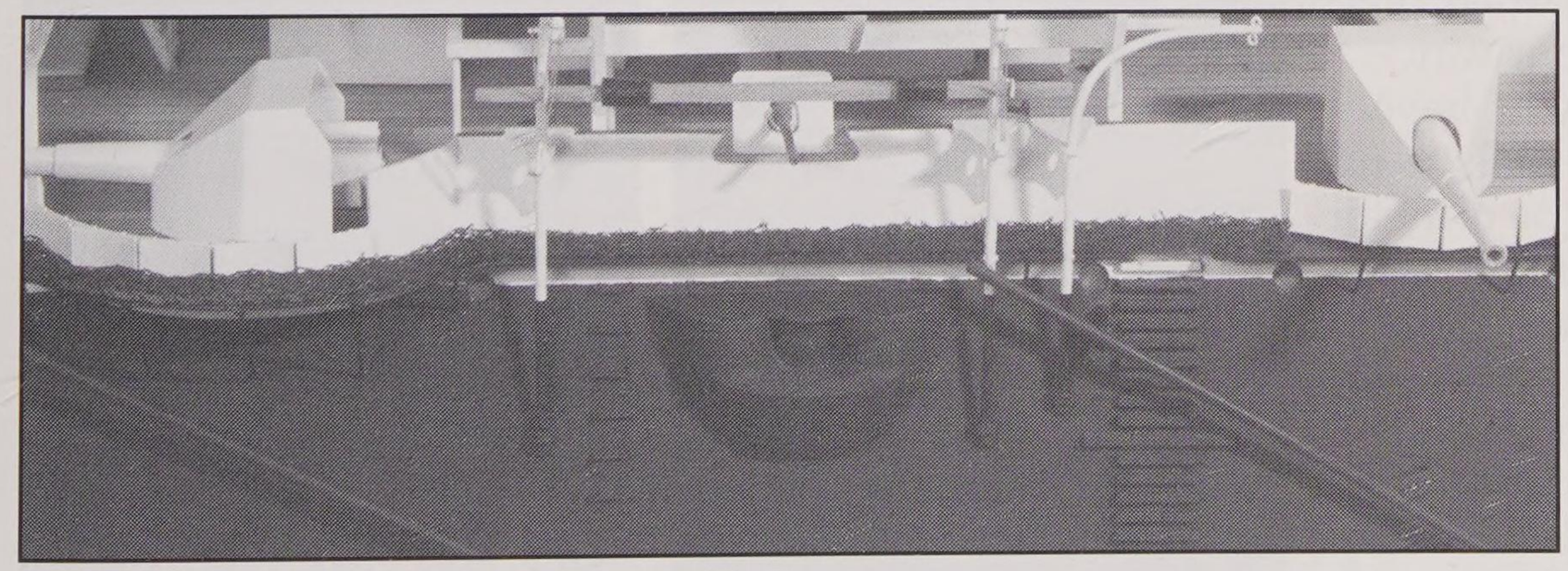


FIG. 2-27: Torpedo nets on *Empress of India*.

Mooring booms

These were provided as a mooring facility for ship's

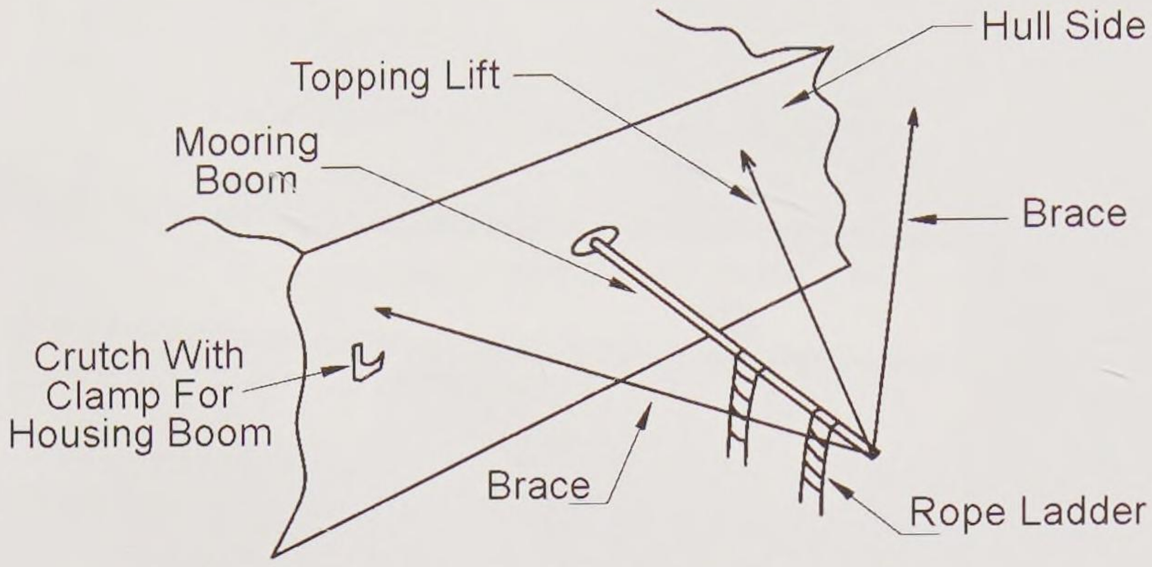


FIG. 2-28: MOORING BOOM RIGGED

FIG. 2-29: Mooring boom stowed on *Victoria*.

boats and visiting vessels (**Fig. 2-28**). The booms, consisting of a horizontal, usually wooden, boom rigged at right angles to the ship's hull, is supported by a topping lift and a couple of stays. They usually had rope ladders attached for the crew's benefit. The hull end of the boom had a swivel attachment so that it could be swung in to lie against the hull when not in use. **Fig. 2-29** shows *Victoria's* stowed mooring boom. A crutch on the hull is fitted to house its free end. This attachment has a clamp to secure the boom.

Duilio starboard mooring boom is housed aft, whilst the port is housed forward.

Rung ladders

Ladders can be free-standing or merely rungs attached to a hull side or to masts. The rungs can be pieces of bent wire or special etched U-shaped parts. The main problem here is accurately locating the receiving holes. These can be carefully – very carefully – marked out and drilled. However, they are not easy to mark out accurately, and secondly, particularly with wood, it may be difficult to drill accurately. With any kind of grain, small drill bits tend to go their own way, which may not be your way.

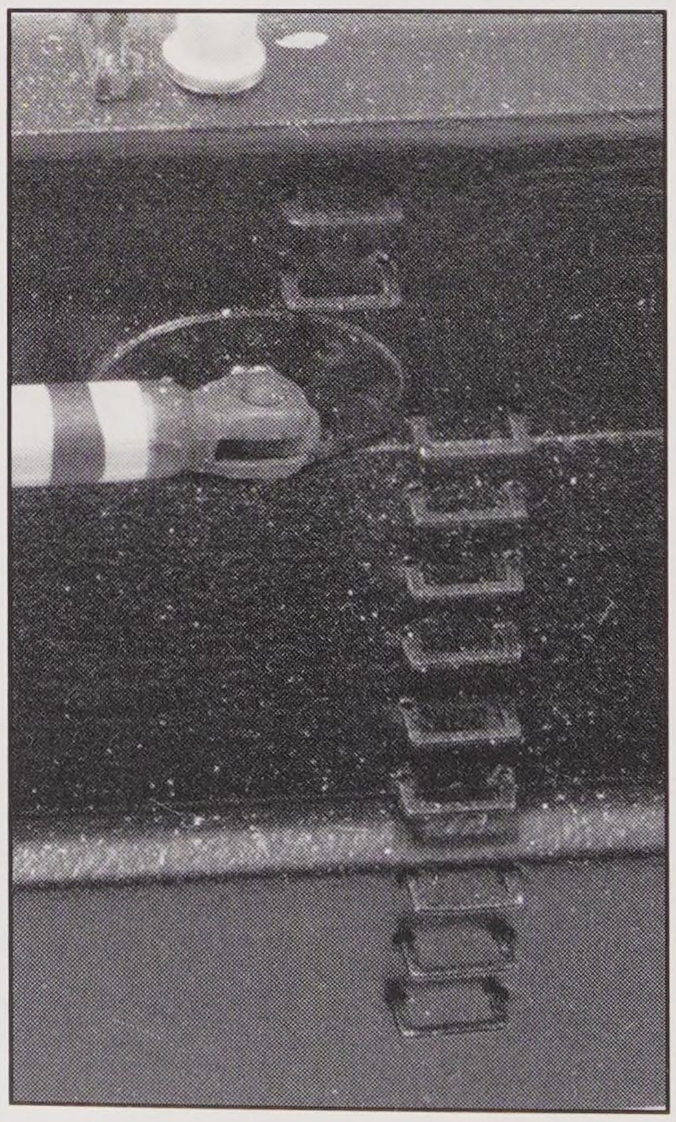
An alternative method, if you have a milling machine, is to use the dials to index the holes. Again, this may be okay for masts and the like, but it is difficult to apply this approach to a hull side – and you need a mill.

Incidentally, if the protrusion of the drill bit from the chuck is kept to a minimum, the resultant extra rigidity aids accuracy. Unfortunately, it also can increase the risk of breaking drill bits.

FIG. 2-30
LADDER RUNG
TEMPLATE

Another more universal method is to use an accurate template to drill the holes. If you are using the etching process, use it to make a template. Whether you draw your artwork on a drawing board or CAD, an extremely accurate template for positional accuracy and hole size is "falling off a log" easy. Such templates also can be made for other jobs similar in nature. **Fig. 2-30** is the template for *Duilio's* hull rungs, and **Fig. 2-31** shows them in situ.

Some ladders are merely protruding solid steps fitted to the hull side as seen in **Fig. 2-32**. This is reminiscent of ships from the "wooden wall" era. They used this design below the



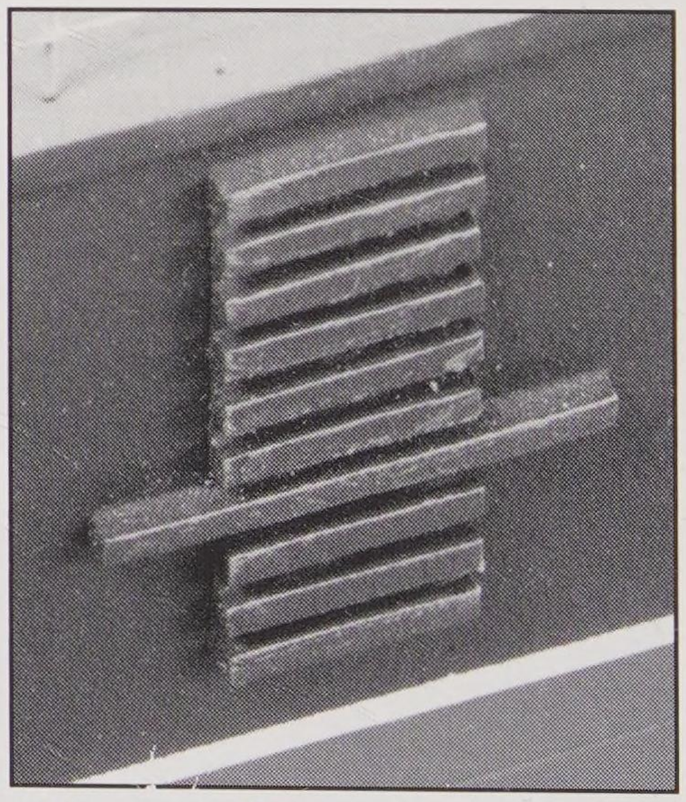


FIG. [illegible] (left): Rung steps on *Duilio* [illegible] Wooden steps

main boarding point. Again, accurate placement is all-important. A template could be etched for this purpose as well.

Port holes (scuttles)

A very painful subject this, as drilling holes into wood does not always achieve the pristine result required. Instead, one gets a hairy orifice of dubious diameter. Several ways exist to overcome this problem:

1) You may find a *blunt* drill bit is much better than a sharp one.

2) Try putting in a pilot hole first before opening it out to size.

3) Experiment with drill speed – a fast drill is usually better.

4) Do not use a big power drill, as its weight can take over and decide where it wants the hole. (A variation of Murphy's Law states that it will not be where you want it.) Use a miniature of the "Minicraft" variety, as they are much easier to control.

5) Drilling through another piece of wood clamped to the hull side almost guarantees a successful result. The problem here is twofold, boring the hole in the correct place and clamping the wood. The first can be overcome by drilling a series of small pilot holes in the hull and piece of wood, then using a wire to locate wood to hull prior to clamping.

6) Yet another way is to drill smaller than required, then grind to size with a tapered grinding stone in a miniature drill. Miniature, below 3mm diam., stones with a slow taper are available, but you will need several to do any sized job. This technique really works, but is a bit long winded.

The answer is to thoroughly experiment with a sample of wood from which the hull is made before tackling the job. If the wood is a bit woolly, stabilize it with a drop of thin, runny cyano.

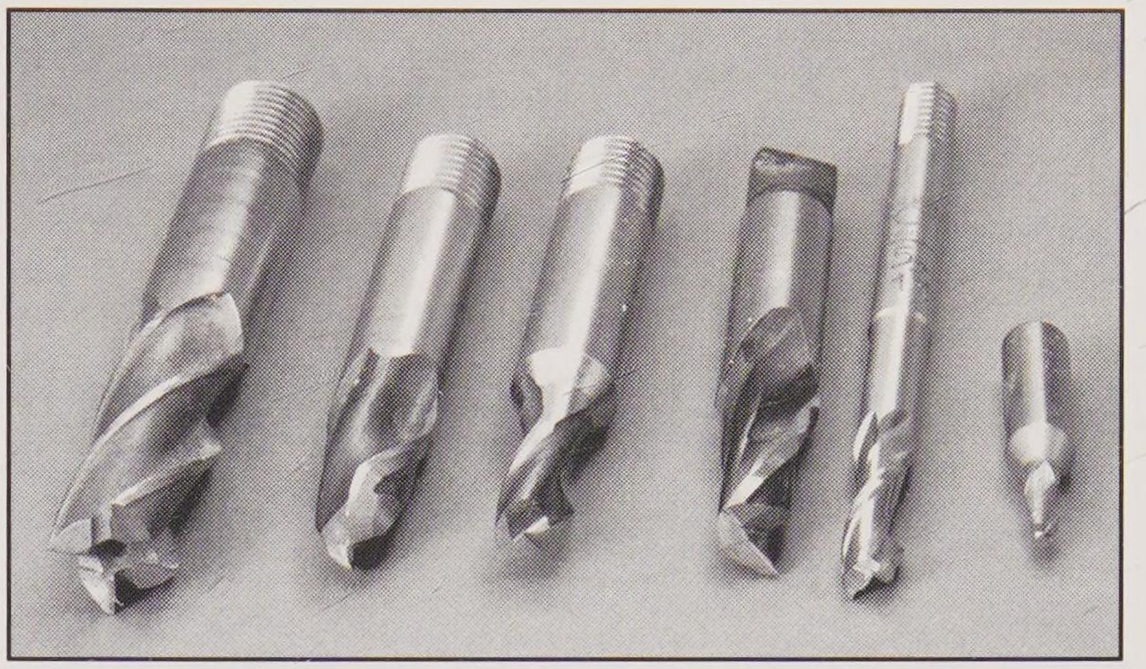


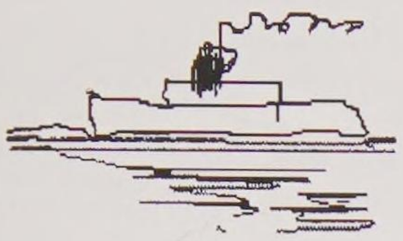
FIG. 2-33: End mill (left) and slot drills.

Glazing ports

I use slugs of transparent, round styrene or Perspex plastic rod for this. Slugs are turned, if necessary, and parted off in a lathe – another wearisome job, but someone has to do it.

Ports in Perspex superstructure

If you make the superstructure of clear, transparent Perspex (acrylic sheet), the ports can be simulated by machining in flat-bottomed recesses about 0.005" to 0.01" deep using a slot drill. Mask these recesses before spraying. Punching out discs of masking tape is probably the best way to achieve this. Slot drills are milling cutters that produce flat-bottomed holes. End mills are essentially made for cutting slots and cannot be used for producing holes, as they cut only on their sides. **Fig. 2-33** shows an end mill (left-hand side) with four slot drills Second from the left is a bull nosed type, which produces a hemispherical bottomed hole. They have one disadvantage. Because they have no point, they are not self-locating. Therefore, the work and the slot drill must be held in the correct relationship. If this is not done, the cutter will simply skate across the surface.



Chapter Three

Decks

Duilio had a main deck and elaborate flying deck above, as did a number of warships from this period. In *Duilio's* case, the arrangement was dictated by mounting the main armament in two turrets arranged en echelon (diagonally across the armoured citadel area). This was supposed to allow axial fire by three guns and cross deck firing by the far turret. However, concussion limited axial fire to no closer than 20° to 30° to the fore and aft axis, and across deck firing was liable to cause excessive superstructure damage. A similar layout was adopted for *HMS Inflexible* 1874 (**Fig. 3-1**).

This turret arrangement allowed a much smaller armoured box (the citadel) to protect the ship's vitals, saving much weight when compared to the more orthodox centreline layout with its bigger citadel. In any case, the monster guns on *Duilio* could only be discharged one at a time to avoid structural damage and, as they were also slow firing, the ship would have proved a weak antagonist in battle.

Main deck

The planking of the deck proper required a false deck to support it, and this will be dealt with first. It is normal to curve the top surface of the deck to give the planking the correct camber, which must also be supported. How this is done is up to the model maker. It can be by transverse deck beams, longitudinal stringers, or a combination of both.

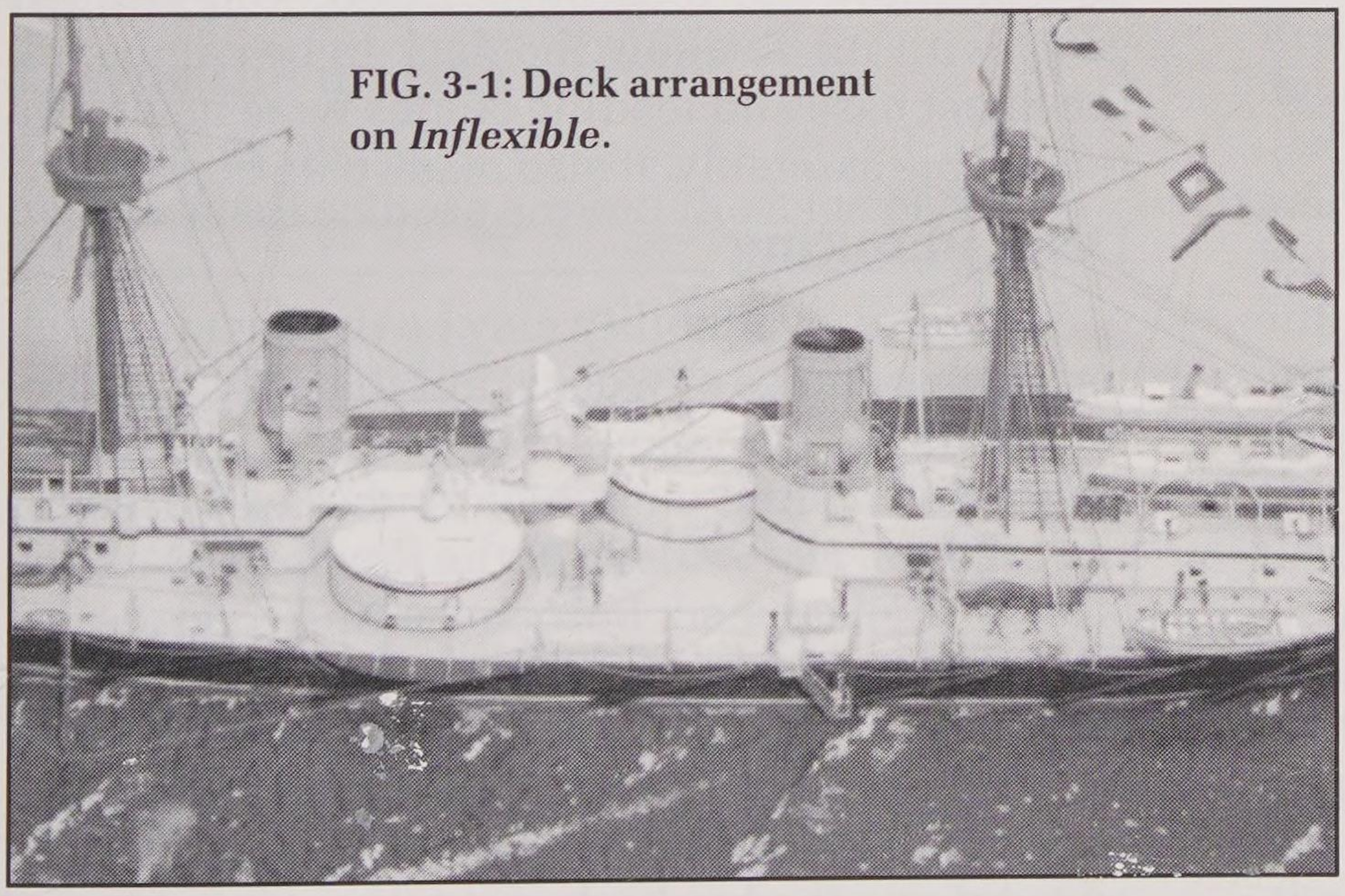


FIG. 3-1: Deck arrangement on *Inflexible*.

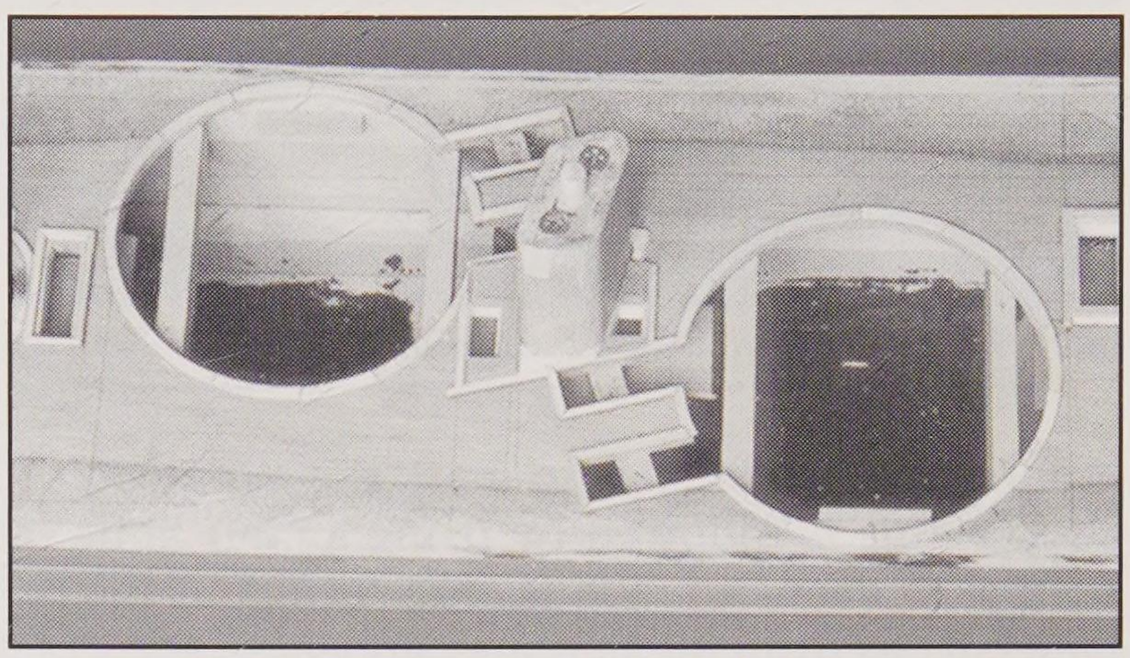


FIG. 3-2: Four transverse deck beams support the turrets, while the two smaller beams support the loading trough. Note the margin planks around the openings.

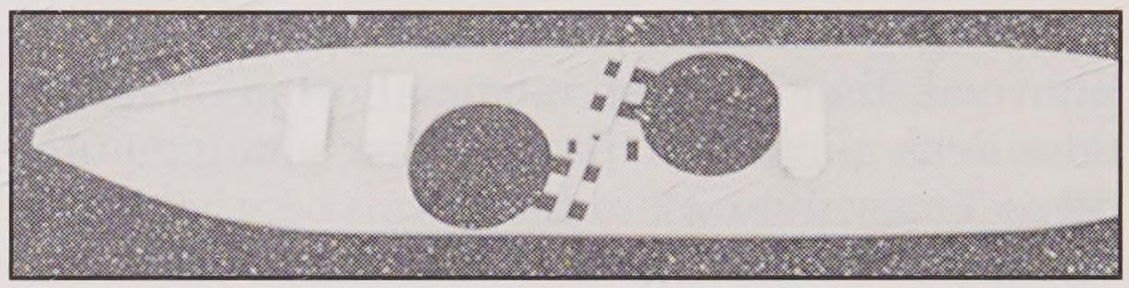


FIG. 3-3: Underside of false deck showing "landings" for companionway ladders.

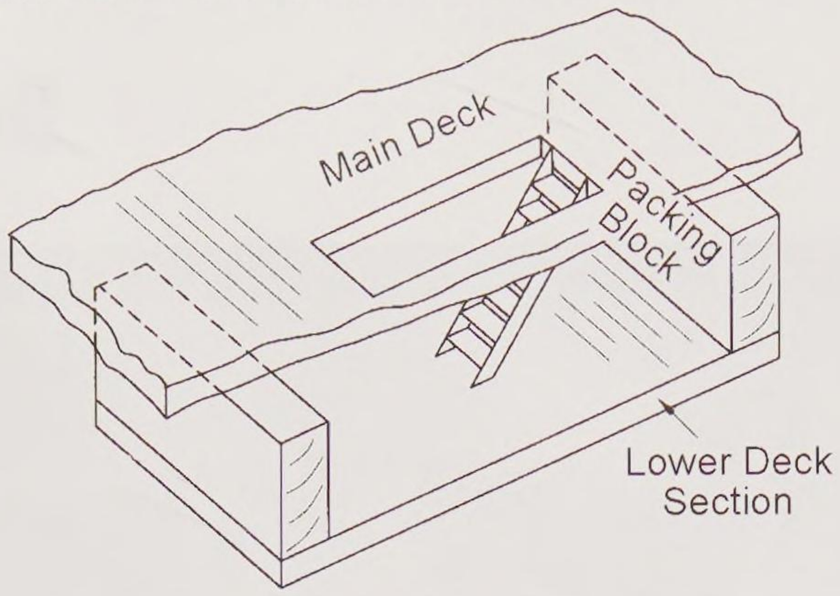
Duilio required four transverse beams amidship to support the two turret assemblies, as it is vitally important to make sure the false deck is secure and does not "give" (**Fig. 3-2**). As the fixed turret bases each had two extensions for the loading troughs, these needed to be supported as well.

Fig. 3-3 shows how a small area of lower deck was fitted under the companionway openings to support the lower ends of the ladders. **Fig. 3-4** shows a small deck area around a companionway opening.

Deck perimeter recess

The false deck was housed in a 3/32" deep recess on the top face of the hull. A marking gauge can be run around the hull top to leave ¼" of horizontal land and vertically

FIG. 3-4: SMALL AREA OF LOWER DECK AROUND COMPANIONWAY OPENINGS



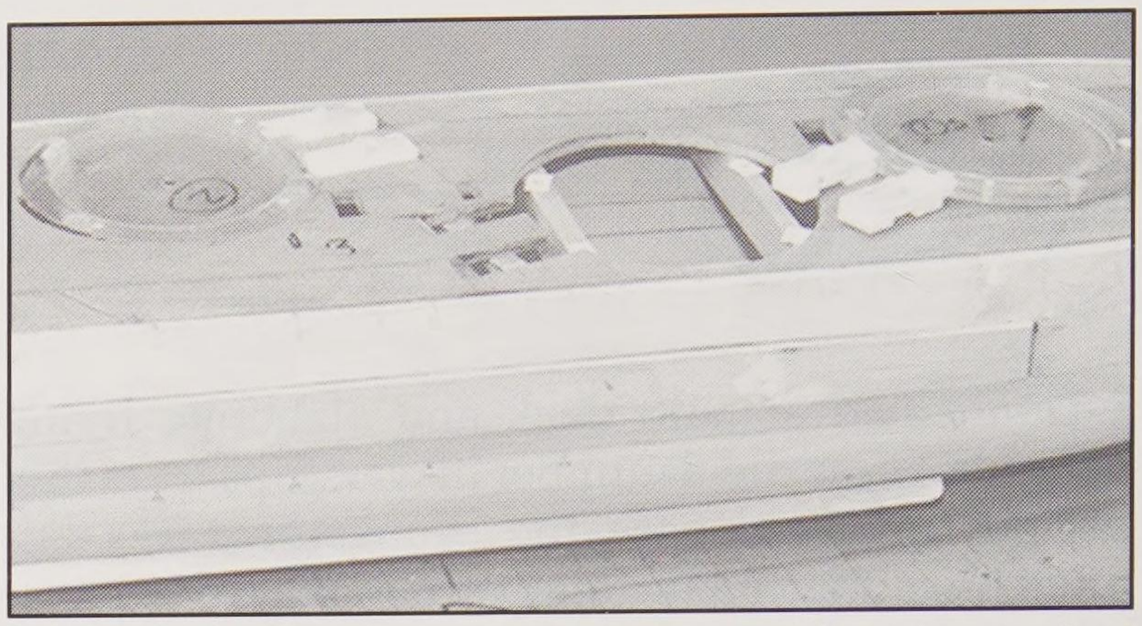


FIG. 3-5: The two Perspex turret bases with their attached loading chutes. The port (No. 2) is in position; the starboard is lying on the unplanked deck.

around the inside edge to mark the 3/32" deep recess. If this is followed by using a craft knife or scalpel to deepen the cuts, chiselling out the rebate isn't as difficult as it may appear.

Deck camber

A deck camber gauge was made from stiff card. As the false deck was made from ¼" thick marine plywood, the 3/32" deep rebate allowed sufficient false deck material to protrude for planing in the correct curvature. Hard board can be used, but it has two disadvantages. It is difficult to plane and push in pins, which is required when plank laying. All the holes piercing the deck were cut out before finally fixing it down, as it seemed easier. However, it would have been better to drill these holes after fixing, as only then were their positions accurately known.

Locating deck components

One problem to consider is whether you intend to put your superstructure on top of the deck or through it. I prefer to seat major pieces through the deck onto a known horizontal flat surface; i.e., the deck beams, and plank the deck around them (**Fig. 3-5**). This ensures that pieces which should be horizontal are horizontal, and eliminates the necessity of curving their undersides to fit the deck camber. The turret seating must, of necessity, lie in the horizontal plane. Of course, this technique requires that extra depth be allowed for these parts. Careful vertical measurements must be taken to ensure all the heights are correct when the deck is finally laid. Getting the vertical dimensions correct can be a problem, allowing for the thickness of the false deck and the planking. Fix a datum, mark it on the plan and stick to it, taking all vertical measurements from it.

Deck camber around the turrets

A major problem lay in how to match the deck camber with the two turrets' flat horizontal bearing areas and their respective loading chutes. Bear in mind that the turrets were not on the centreline, but en echelon, which meant the edge of the turret was close to the deck edge. Perusing the plans did not help much, rather indicating very awkward bits of sloping deck surrounding the turret bases. I thought that solution was improbable owing to the geometry of the loading process. I therefore decided to put a constant camber over the length of the ship, and allow the turret bases and loading chutes to stand clear where necessary.

Most models of *Duilio*, unlike mine, do not show the loading process where correct alignment of the barrels and chutes is essential. (If you do not show the loading position, you can get away with it.) To allow the deck to be cambered, the turret base and loading chutes were made as a removable assembly. It also made painting easier.

Deck planking

As always, availability may be the deciding factor in your choice of woods, but the main requirements are always colour and lack of grain. It may be possible to find out which timber was used for the original. *HMS Anson* of the Royal Navy's King George V class had Borneo white wood decks, whilst *HMS Nelson* and *HMS Rodney* had fir (any evergreen from the *Abies* or pine family) decks. Fir was used, as it was lighter than traditional teak. What its life and durability were can only be guessed at – the books do not tell us.

The choice for the modeller includes boxwood, holly, sycamore, lime, and American linden (basswood). The first two are excellent, but hard to work. I had a supply of holly, so laid a small experimental area, but decided it was too hard to saw and work. However, it looked superb. I have used sycamore and lime, and both produce fine decks. Unless you can saw plank-size timber, sycamore is not usually obtainable, as it is not sold in strip form.

Plank preparation

In this country (UK), basswood is available in accurately cut sheets that can be easily rendered into planking stock. My technique is to spray or brush *one* face with dark grey matt paint. Acrylic paint is excellent. I use dark grey rather than black, as black is a trifle overpowering. This represents the caulking. If you intend to use planks of fixed length, say 20 feet, cut your sheet into appropriate scale lengths (**Fig. 3-6**). Cut these pieces into strips the finished *thickness* plus a cleanup allowance. In this way, the original thickness of the bought sheet becomes the plank *width*. One assumes that the manufacturer's cutting will be more accurate than yours! The thickness dimension is not important, as it will be cleaned up anyway (**Fig. 3-7**).

If you are still with me, you will note that the painted surface has now become one edge of the plank. To simulate butt caulking, use a 2B or softer pencil on one end. If the planks are always laid with the coloured edges to starboard and aft, it will avoid over-egging the cake by laying two coloured edges together.

Laying the margin planks

The first planking stage is to lay all the margin planks: those around the edge of the deck and all the major components such as ventilators, piercing the deck (**Fig. 3-8**). There does not seem to be any hard and fast rule about how this is done. The next stage is to fix the king plank along the centreline.

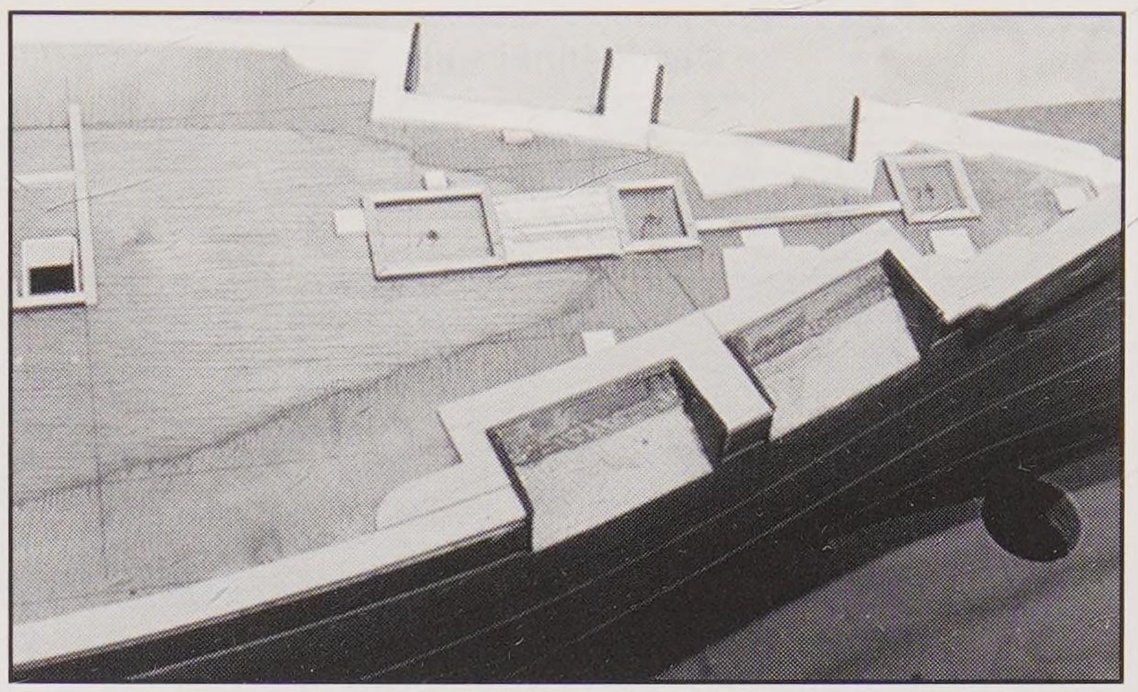


FIG. 3-8: Margin planks around deck perimeter and openings.

Plank arrangement

You need to decide on which planking rules you are going to follow. The planking shown on the drawings tends to be a "two-butt deck" with two unbroken planks between butts. This plank arrangement may have been correct for the Italian navy, but it certainly would not suit the Royal Navy who favoured either a three- or four-butt deck (**Fig. 3-9**). Photographs of Italian ships from the same era seem to indicate a three-butt deck. I decided to assume the arrangement shown on the drawings was a guess and probably incorrect.

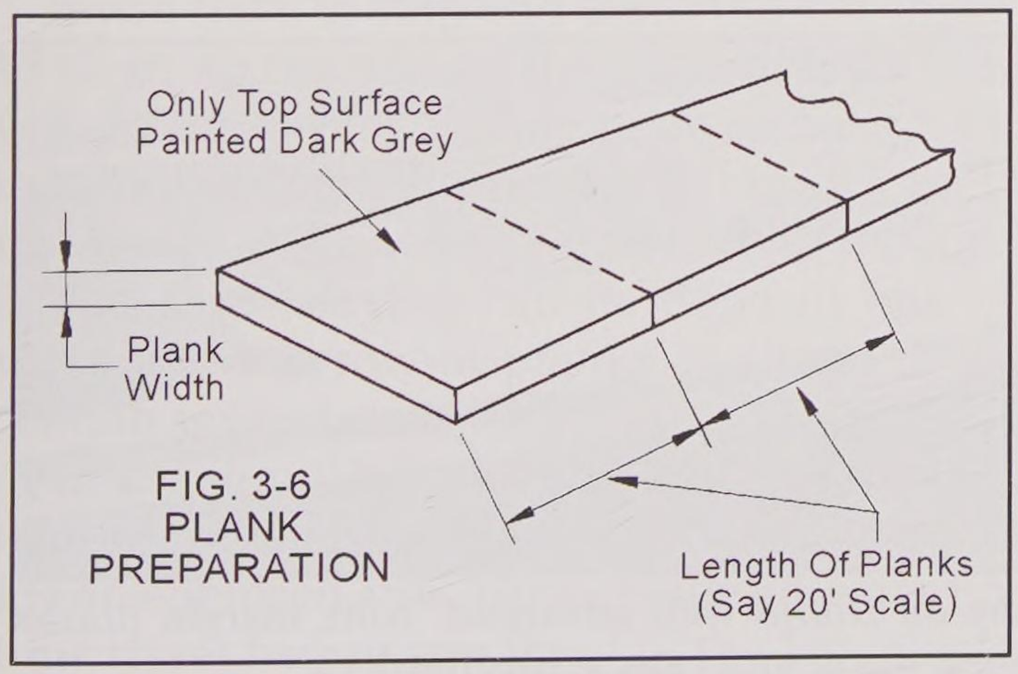


FIG. 3-6
PLANK
PREPARATION

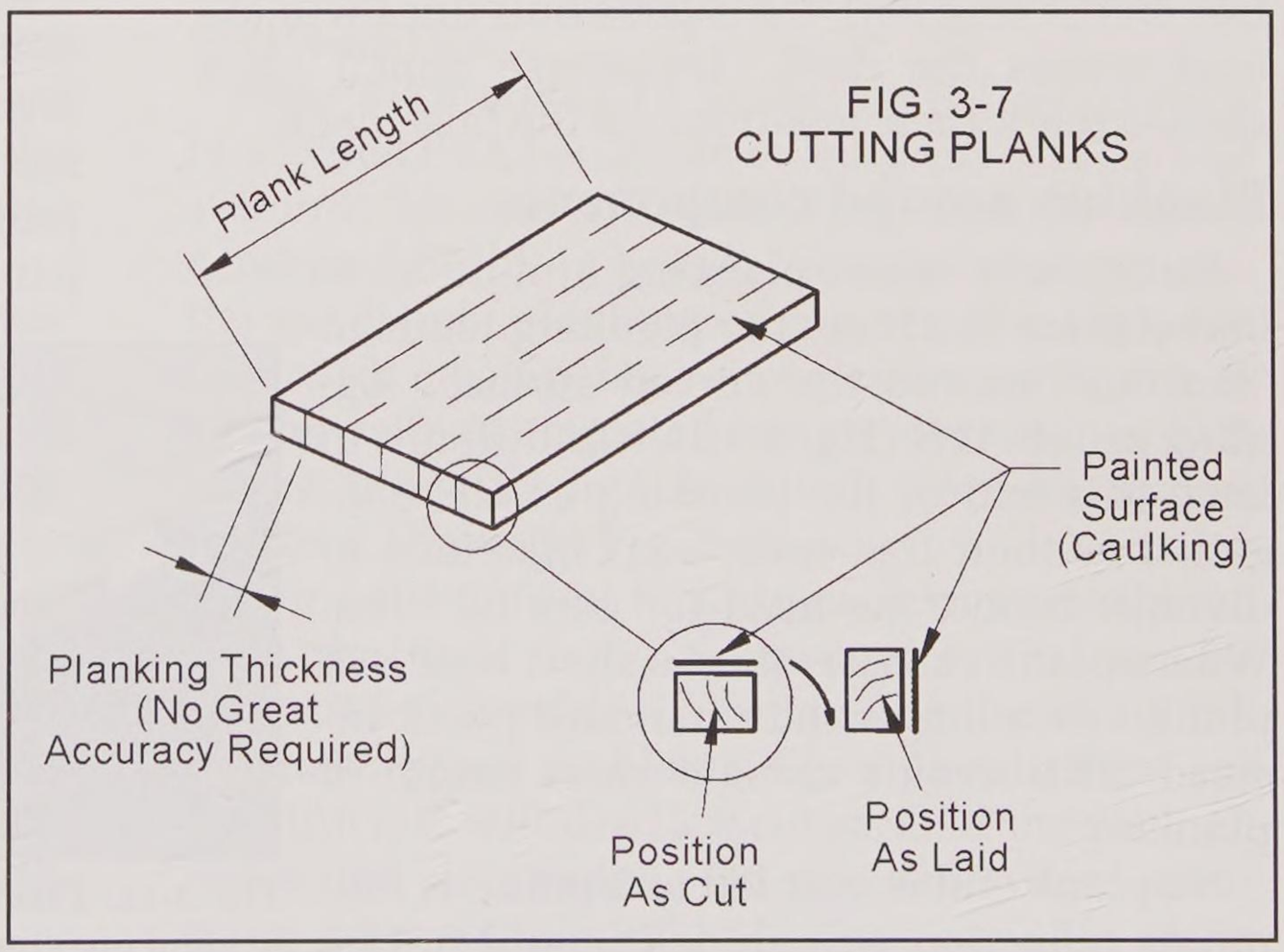


FIG. 3-7
CUTTING PLANKS

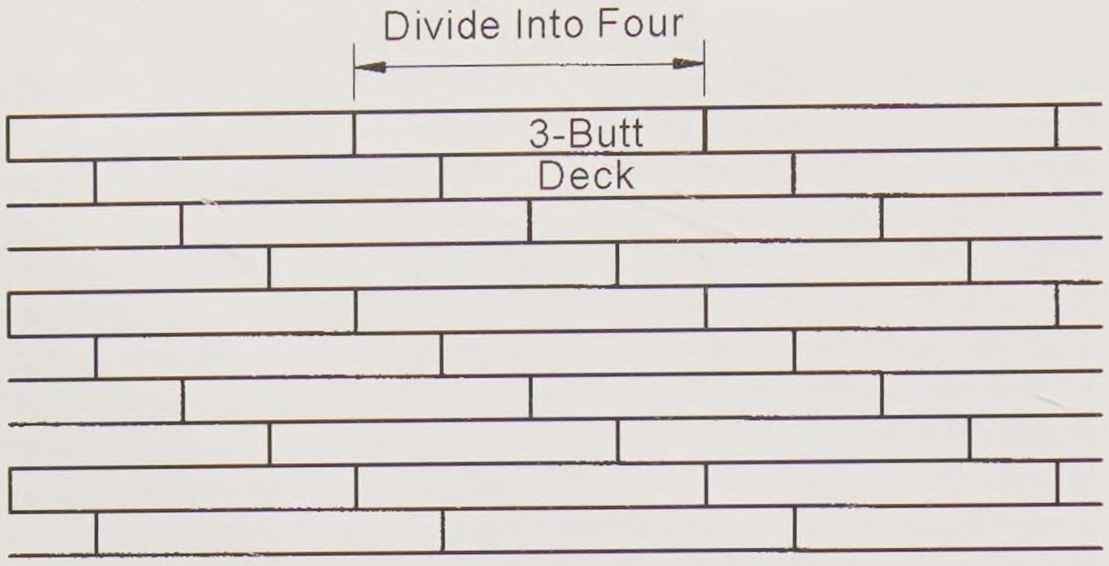


FIG. 3-9: DECK PLANKING SYSTEMS

Thus, I adopted the three-butt pattern and laid the planks to Admiralty specification. It was thought that the plank width drawn was a little on the thin side for 1867. Timber was more readily available at that time. This was later confirmed by a photo of the sister ship *Dandolo*, whose planks, judging from the footwear worn by the crew, were wider than those drawn on *Duilio's* plans.

If the plank length is fixed at 64mm (about 21 feet on the original), transverse butt lines will extend across the deck. Transverse pencil lines should mark their positions on the false deck.

Planking around components

Particularly when planking around a circle, a barbette for instance, the planking tends to "fan out" around the curved surface. Jogging causes this (**Fig. 3-10**). It is difficult to keep this end of the planking as close together as their free ends, so planks tend to diverge; hence, the need for parallel lines. Where plank runs re- quire a short length of plank, use a longer than standard plank instead. This avoids using a short length of planking.

No plank end is ever left as a point. A moments reflection will show it could not be

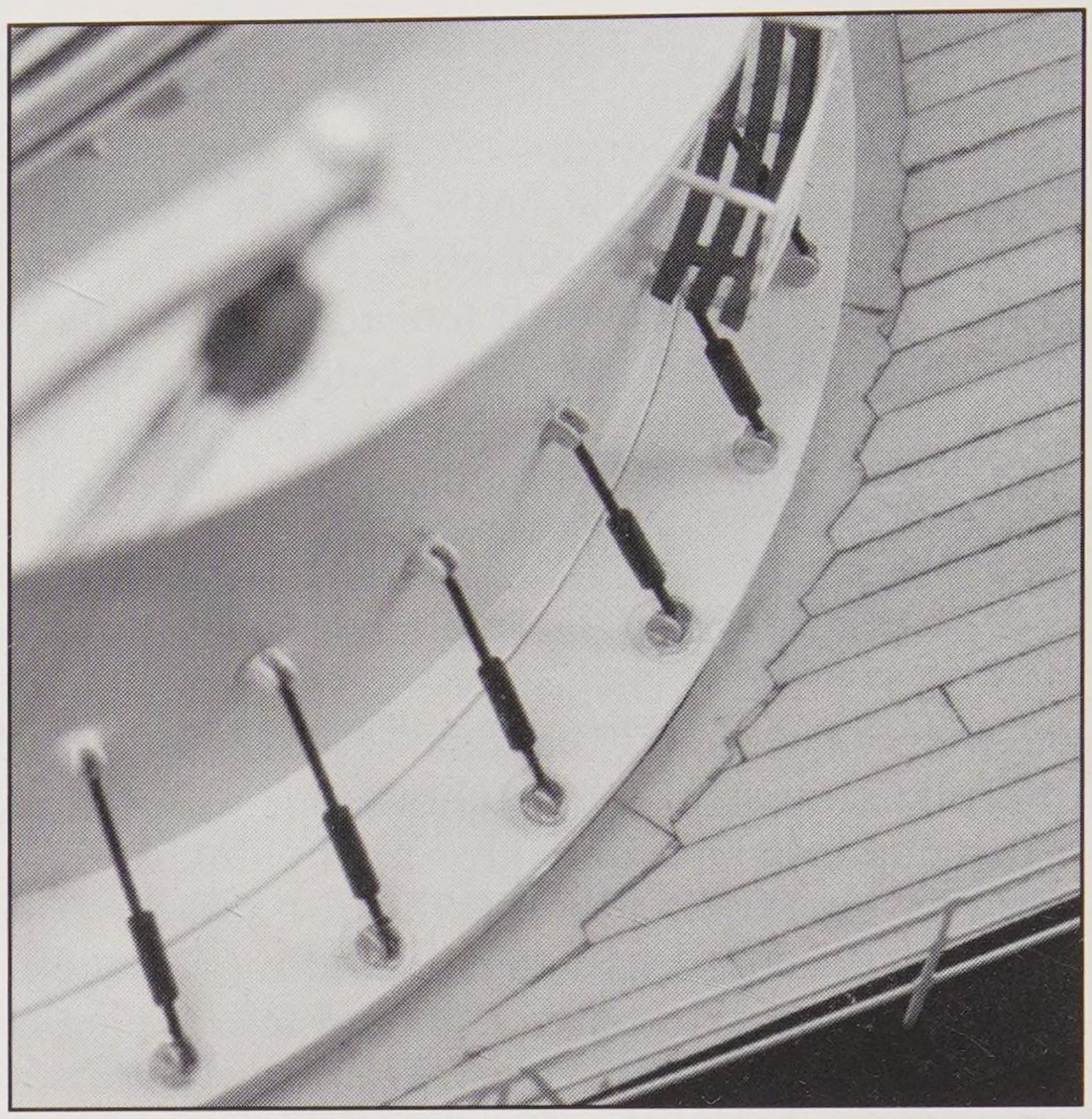
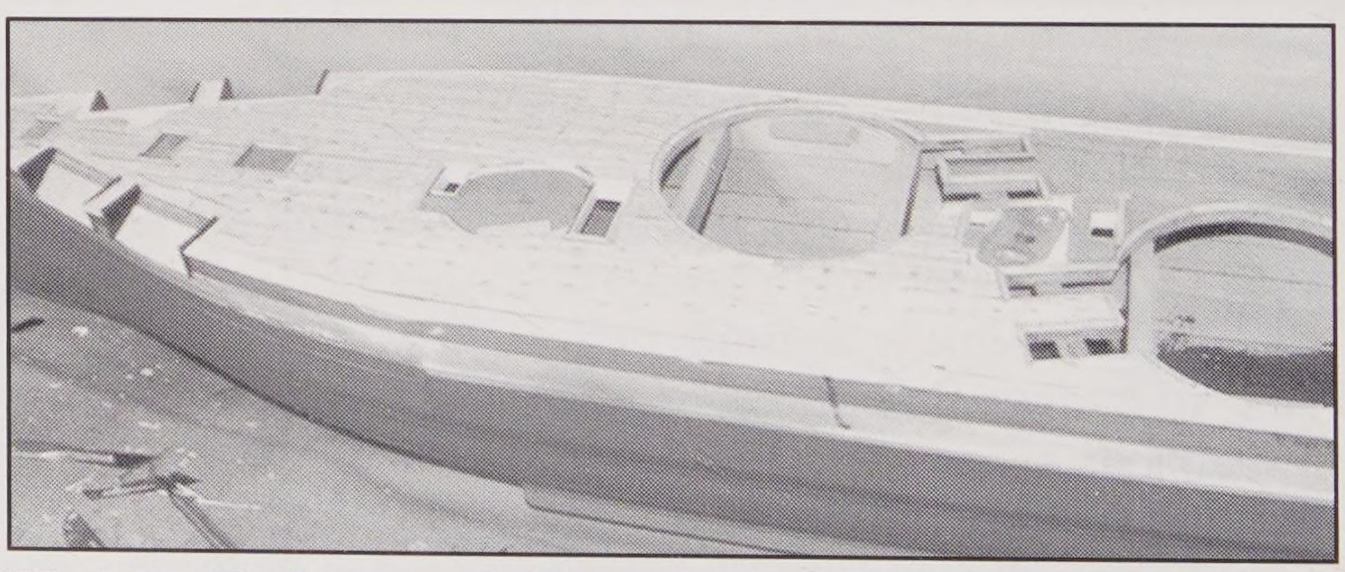


FIG. 3-10: Main deck around the turret showing plank jogging.

secured if it were. Instead, the tapered end of a plank is cut off square; the length of this must be half the plank width. The rule was, if the tapered end of the plank – the snape – was greater than twice the width of the plank, then it had to be joggled into the margin plank. From observation, these rules were bent at times, but they were the rules the Admiralty laid down.

Laying the planks

Planking, if started correctly, should proceed easily if somewhat tediously. It's a bit like brick laying – just get on with it and your reward is to see it grow (**Fig. 3-11**). Once you have achieved a properly laid deck, you will never again revert to pencil or ink lines on a piece of ply! To avoid vis-



FG. 3-11: Planking on *Duilio* well advanced. Note margin planks around openings and plank butt runs across the deck.

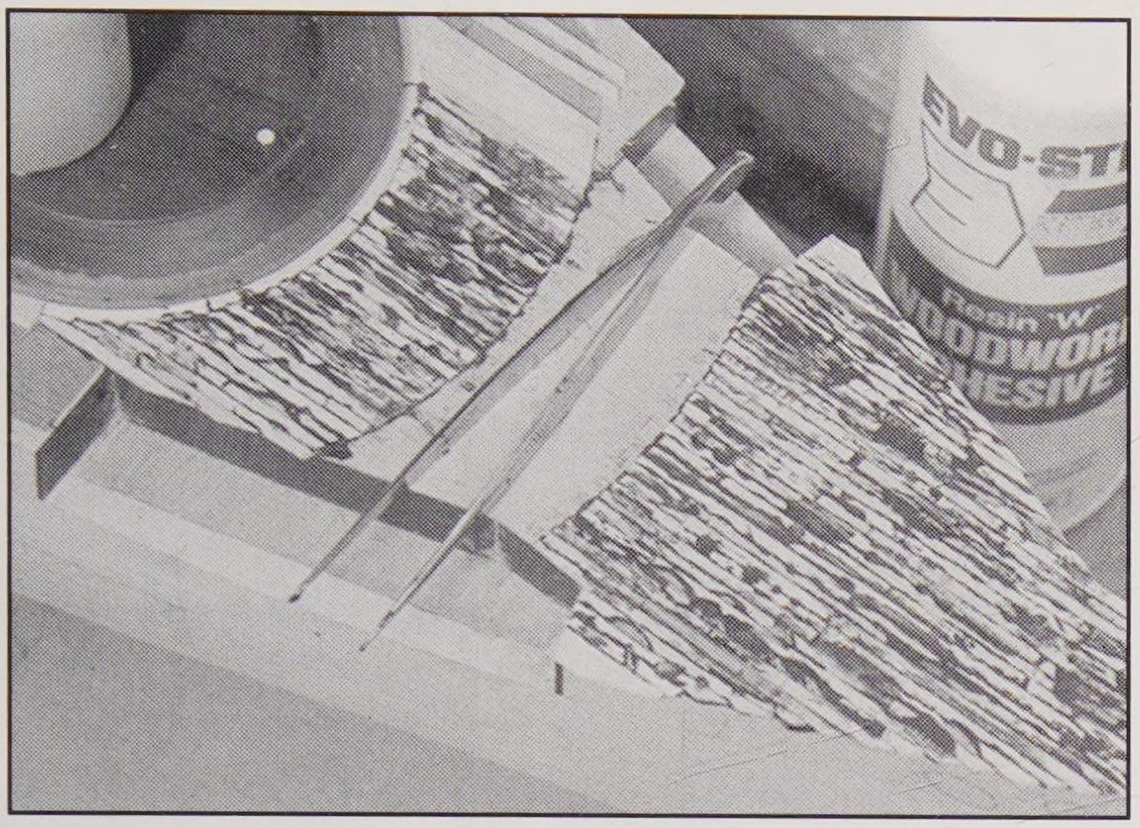


FIG. 3-12: Plank laying using poster coloured PVA.

ual monotony, choose planks of different colour. Basswood varies from almost white to very pale brown. Mix your planks randomly to ensure your deck will be seen as properly laid. I suspect the white is the sapwood and the brown is the heartwood, as it is more difficult to cut than the former.

Start against the king plank. Use ordinary white PVA woodworking glue for the job, wiping off the exudate that results when packing a new plank against its already laid companion. Push a line of new planks together using a straight piece of brass or aluminium. On no account use steel, as PVA glue will stain the wood black. (I believe it has to do with the glue's acetic acid content.)

If you wish, secure your "pusher" tight against existing planking with dressmaking pins. This need not be for long, as modern PVAs "grab" much quicker than those of yore. Also, make sure the planks are butting tightly. It is very easy to get an unwanted end gap between planks. If the transverse pencil lines are watched, this should not happen.

If you have to stop and leave the job, make sure to clean up the edge of the last plank laid and any glue in the corner. Failure to do so means surplus dried adhesive will prevent you from snugly laying a new plank when you return to the job.

The actual laying can be done in one of two ways; lay one row of planks at a time or dry assemble several rows before gluing on mass. However, if using the latter, you can unwittingly mix up the rows. It is the best method if you are planking an enclosed area, because the glue has not had time to set before you force in the last plank.

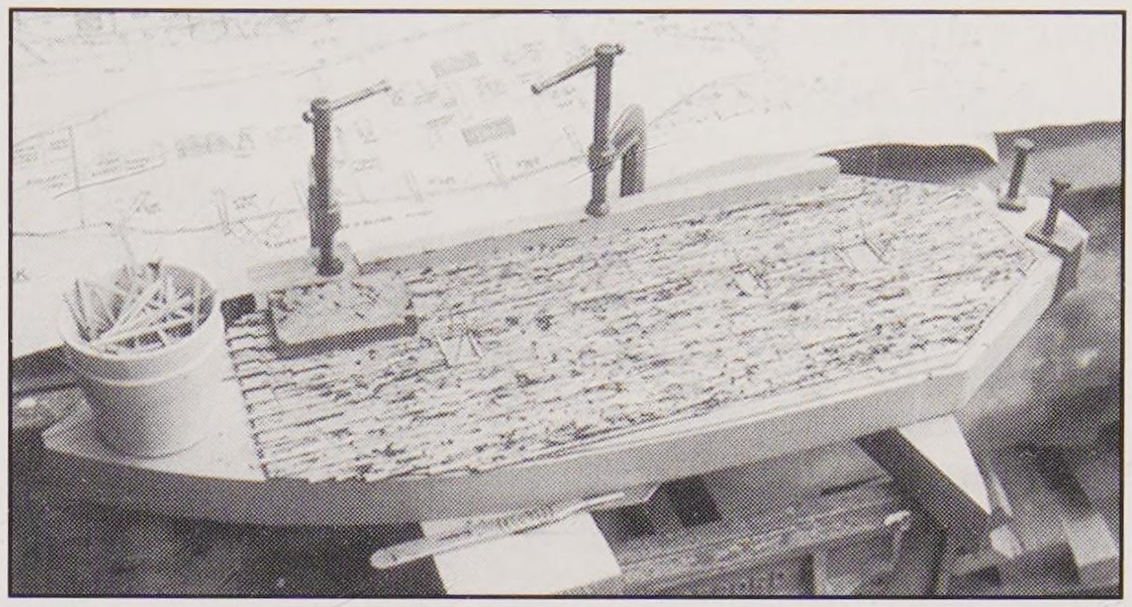


FIG. 3-13: Planking *Victoria's* freestanding deck.

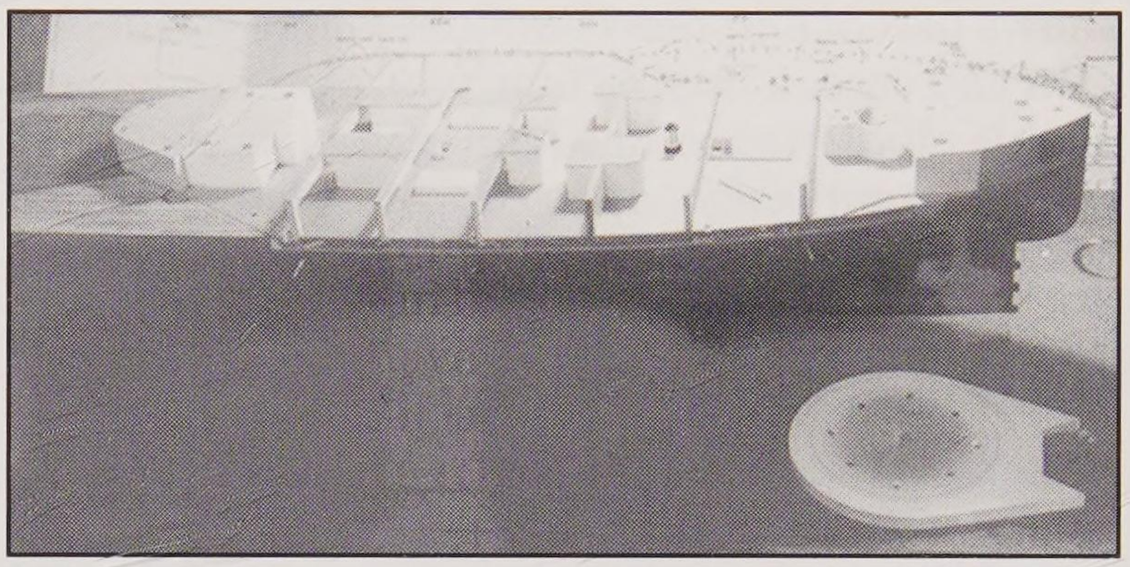


FIG. 3-14: *Victoria's* completed battery deck. Object at right is the main turret's Perspex glacis plate.

Final cleaning up

Advanced Ship Modelling advocated using an adjustable mouth plane for this job. The point being that sanding would rub the dark caulking material into the grain and destroy its appearance. This advice was a throwback to the days when I used white PVA glue coloured with black poster paint powder to simulate caulking. The exudate dust from that certainly would have ruined the deck's surface.

Figs. 3-12 and **3-13** show planks glued with blackened PVA being laid on *Empress of India* and *Victoria*. *Victoria's* freestanding deck is on its cambered building board. It consisted of a three-tier sandwich, planking on top of a thin plywood base with a balancing veneer underneath. **Fig. 3-14** shows the completed battery deck minus bulwarks, but with deck beams in place to support the deck shown in **Fig. 3-13**.

Using the present technique, it was possible to sand the deck using a powered orbital sander without any trouble. However, the use of such a tool has its own problems. Given the slightest opportunity, it will dig in a corner and produce an unwanted depression. Do not use coarse abrasives, get a companion to observe one side while

you watch the other, and do it very, very slowly.

Finishing off

Finishing off the deck is a matter of choice. Two coats of matt varnish are probably correct, but unexciting. Perhaps eggshell is a better bet. When varnishing, take care to clean up the vertical edges around openings, particularly those housing components such as barbettes. Failure to do so will result in a bead of dry varnish around the edge, preventing the fitting of components and causing much subsequent annoyance. **Fig. 3-15** shows part of *Empress of India's* completed deck.

In any case, a final fitting before painting is desirable. Experience has shown that parts fitted, say, six months ago, often do not fit later. I do not know why. Perhaps it's just a case of the assembly settling, but it happens.

Main deck/flying deck relationship

Before describing the flying deck's construction, it should be pointed out that the spatial relationship between the two decks must be correct. They are connected at four points: the mast, both funnels, and binnacle supports. The mast, aft funnel, and binnacle supports lie on the fore and aft centreline. (The lower end of the latter actually sits on top of the deckhouse). The fore funnel lies 15mm to port, allowing the starboard turret to fire directly ahead.

To ensure that the four contact points are in their correct positions on both decks, the flying deck could be made first and used as a template to mark out the false main deck. Alternatively, a template could be made from which both decks could be marked out. However done, it is imperative to get this bit absolutely correct; any errors will be difficult, if not impossible, to correct afterward, particularly if the margin planks outlining the funnel positions have been laid.

Flying deck

Experienced modellers quake at this item. A mainly unsupported laminate stuck up in the air is liable to twist and distort at its leisure – and the weather. The secret is to produce a balanced laminate. If one side is veneered, the other side must be similarly veneered to avoid distortion. More details will be discussed later in this chapter.

Since the deck planking was wood, I decided to make the whole flying deck from wood, too, as I

FIG. 3-15: Deck on *Empress of India*.

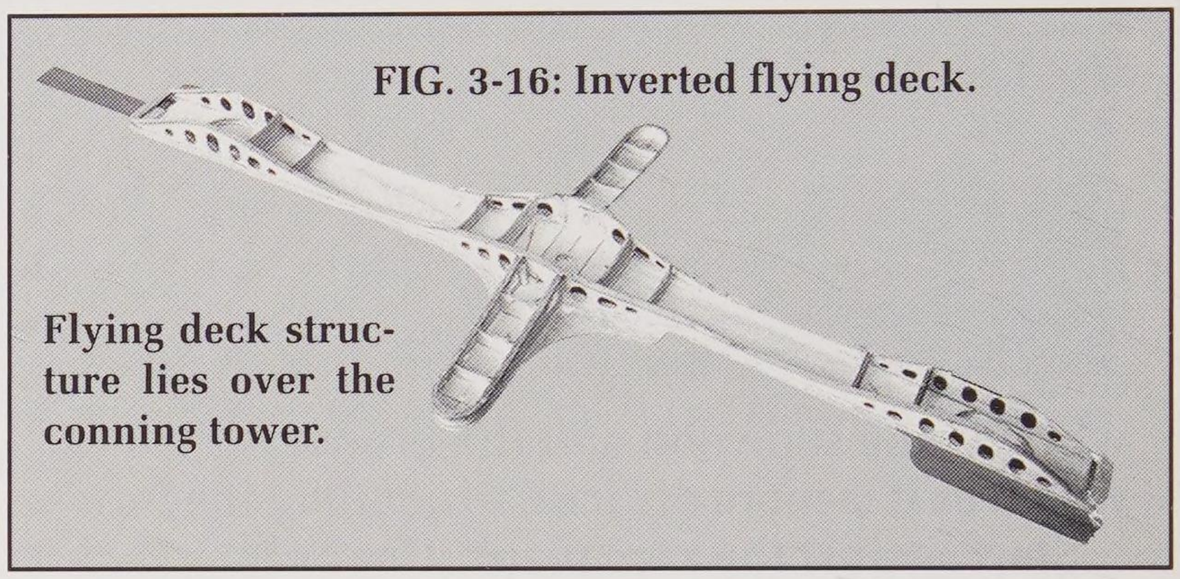


FIG. 3-16: Inverted flying deck.

do not like joining relatively long pieces of different materials. This is because differential heat expansion problems may cause glue lines to break down after a time. I would have preferred making the vertical webs from plastic, as it is easier to get a decent paint finish on this material than on wood.

Fig. 3-16 is of *Duilio's* completed but unpainted flying deck. It is inverted to show its construction. **Fig. 3-17** (c/s) shows the centre of the inverted flying deck.

The basis of the flying deck was a sheet of 0.5mm plywood. This was pinned down to a flat fibreboard and the outline marked out. Margin planks were laid to this line together with any

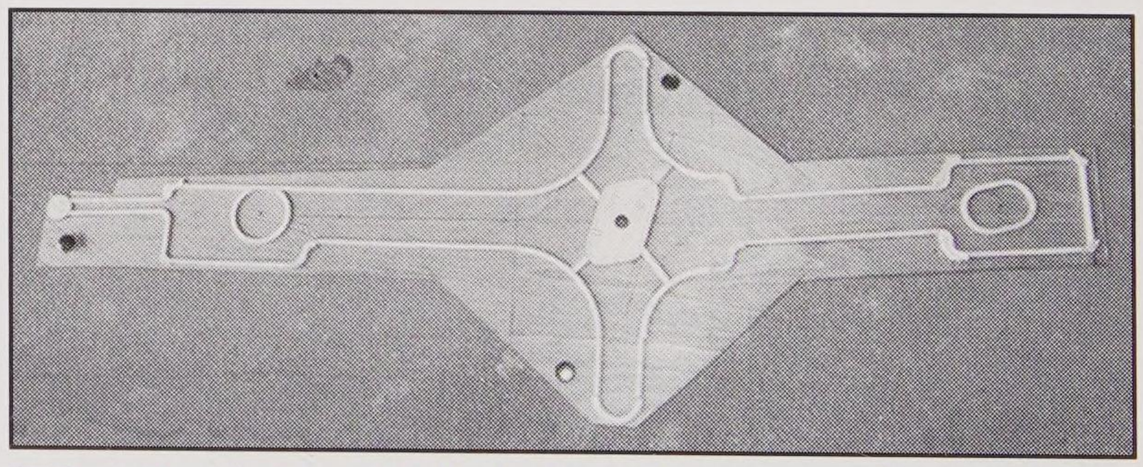


FIG. 3-18: Margin planks laid on the 0.5mm plywood foundation.

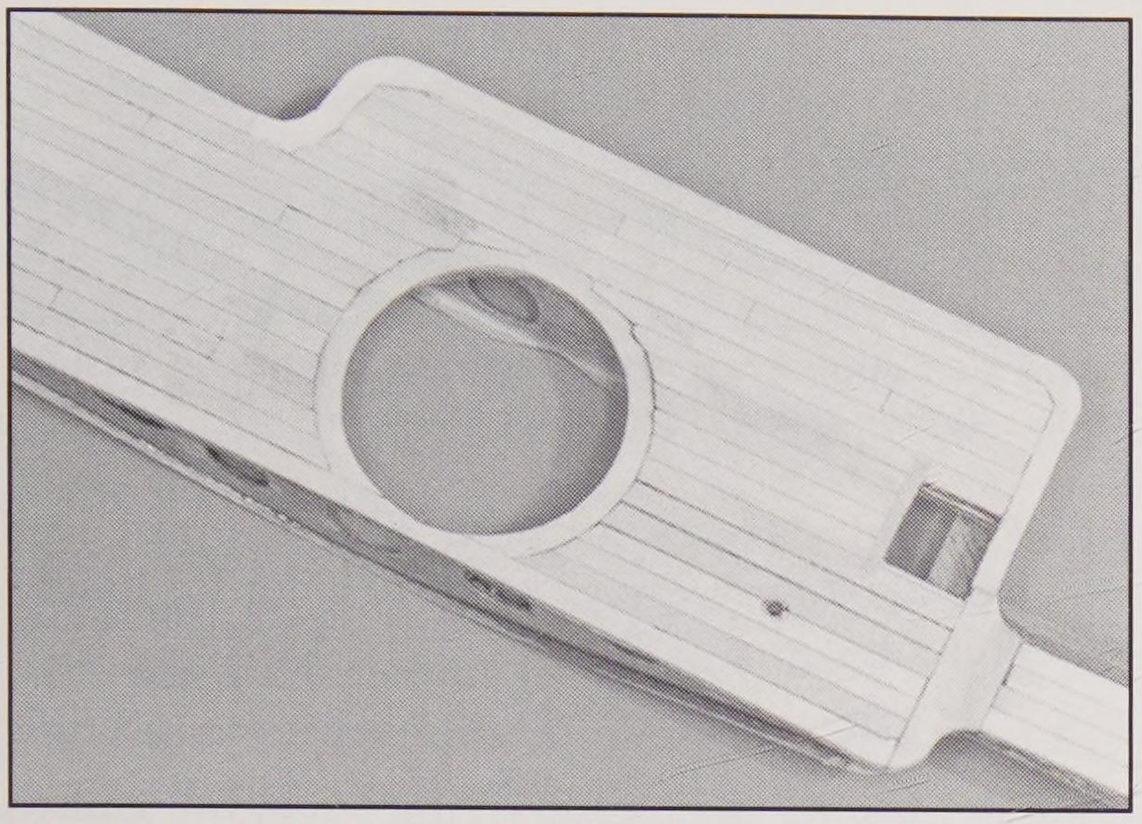


FIG. 3-19: Planking completed at the stern of flying deck.

planks surrounding holes, and the direction of the plank runs was marked (**Fig. 3-18**).

Planking

The planking was carried out to Admiralty rules and not as the plan shows where, in the writer's opinion, the butts were set too close. The same technique was used on the main deck. Evidence for the size of planks and butt arrangement comes from photographs of Italian ships found in *Navy and Army Illustrated 1896*. **Fig. 3-19** shows the flying deck's completed stern planking.

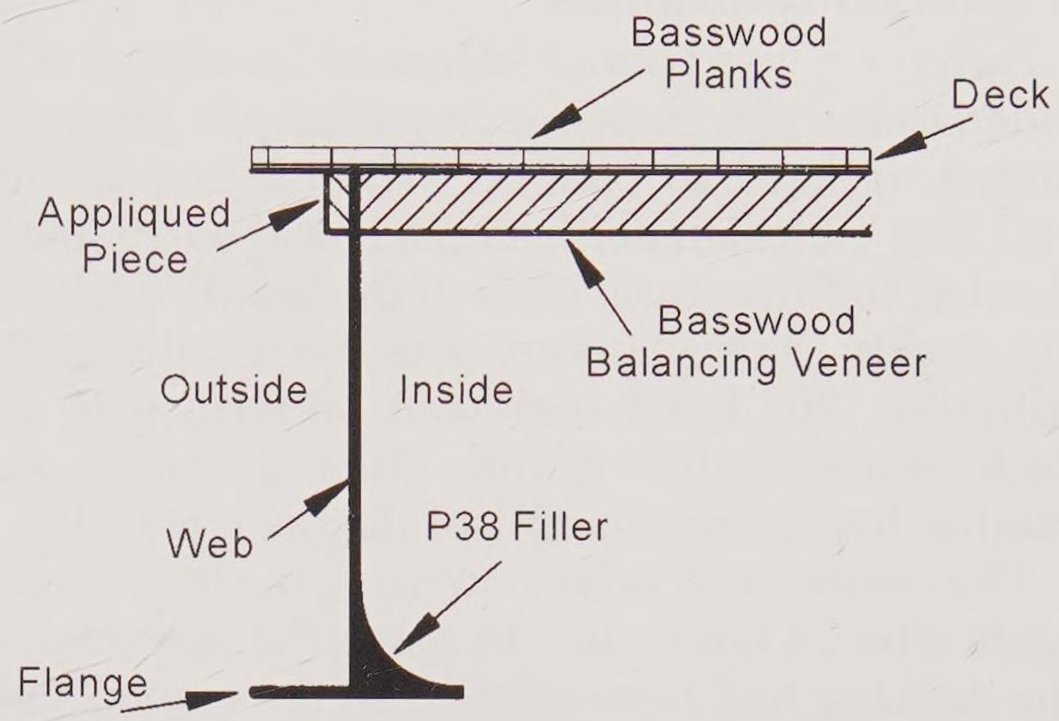
Planking was then completed in the same manner as the main deck using a nominal plank length of 20 feet. The planks were joggled where appropriate and fixed with white glue. Each plank's starboard side and aft end was rubbed with a 6B pencil to provide a caulked effect.

Fitting the flanges

With the planking finished and cleaned off, the assembly was turned upside down and pinned to the board. This enabled the undercarriage to be attached. Firstly, a 3mm thick piece of basswood was fitted corresponding to the width between the side members. This balanced the planking (veneer) and provided an edge to support the side webs, also made from 0.5mm plywood. (**Fig. 3-20** shows a cross section through the flying deck). The webs were first made in card to get the correct shape, including the lightening holes, before transferring to the plywood.

Several transverse members also were required and fitted; these provided strength in torque and prevented twisting. Straight strips of 0.5mm plywood were attached under the flying deck to the side of the webs to simulate the angle iron joining the two.

FIG. 3-20
CROSS SECTION THROUGH FLYING DECK
Deck, Web, And Flange 0.5mm Plywood



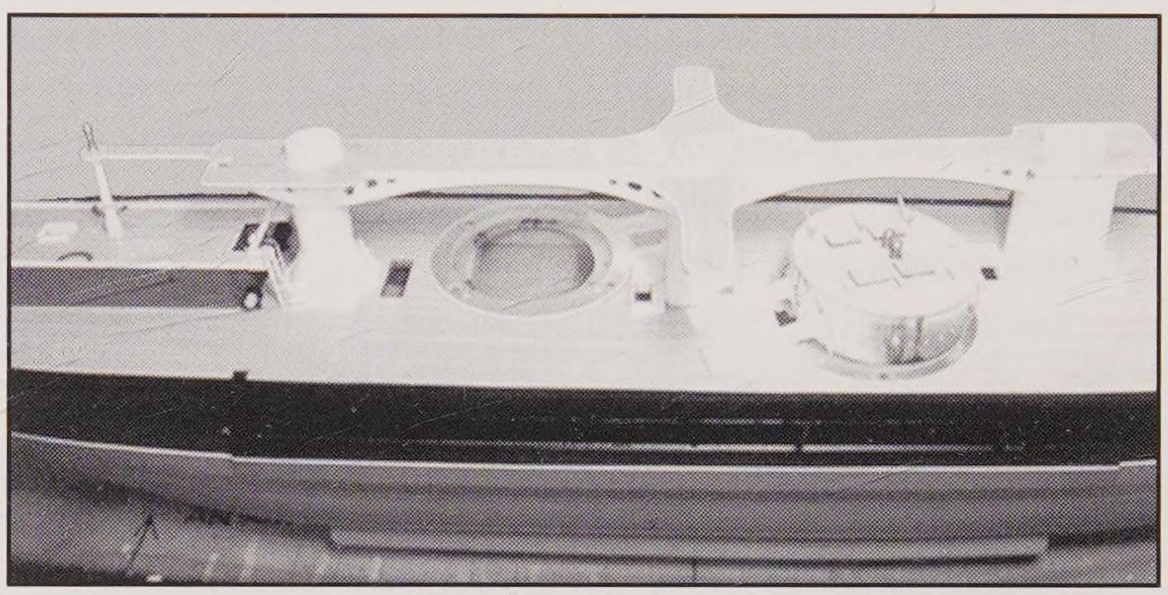


FIG. 3-21: Dry assembly of flying deck.

Lastly, the flanges of the webs were fitted to their lower edges. These were strips of 0.5mm plywood 3mm wide. Fixing these was a problem, as balancing on the edge of the web gave little support. The solution was to hold the strips in position with hair clips and secure with cyano. Cyano does not glue wood very well if the wood is dry, so the joint was damped before applying the adhesive. This secured the two members, but not firmly, so the inside right angle was filled with Isopon (**Fig. 3-20**).

The excess 0.5mm plywood was then cut off and the edges cleaned up. Two coats of eggshell varnish were applied to the deck surface. Thereafter, the flying deck was kept face down on a flat surface and weighted to maintain its flatness and geometric accuracy until it was finally fitted to the ship. From then on, its stability was in the

hands of the gods. **Fig. 3-21** shows the flying deck offered up to its mating components.

Balanced laminates

Perhaps a word about balanced laminates is in order, as the phenomenon, especially to the uninitiated, is hard to believe. When I first started building Victorian battleships, I used 0.015" brass sheet as the structural basis of the lightly built flying decks. Deck planking was fixed with epoxy adhesive. The brass had been preformed to the deck camber before gluing. After 24 hours, the camber had disappeared and the deck was flat.

The camber was reformed using the fingers, but again after 24 hours, the deck was flat. Remember, the decking had been applied to the convex side of the brass. Stability was achieved only by applying a balancing veneer to the underside (the concave side). This is hard to believe, but the strength of thin wood veneer is enormous. *Always*, but always, make a balanced laminate unless you want unpleasant surprises.

Incidentally, photographs of Victorian Royal Naval ships show the caulking, at least on some flying decks, was white and not black. One wonders what it was – white lead?

Rectification and painting

After masking the finished deck, a white primer aerosol was applied as the final finish. The first coat – my rectification coat – showed all the imperfections, which were filled with Polyfilla Fine Surface. This comes in a tube and therefore does not go off as quickly as in an opened tin. It is only for *minor* cracks and imperfections, but at this stage your workmanship should be giving you only minor faults anyway.

It pays to spend time now getting things as perfect as possible. A whole morning can pass just filling slight cracks and cleaning up edges and rough surfaces on an item of this complexity. Never grudge the seemingly large amount of time that must be dedicated to this work. It is effort that elevates a "good" model to "excellent," and wins gold medals.

Before finishing the paint job, the flying deck must be dry assembled on the model (**Fig. 3-21**). The three main supporting parts are the two funnels which pierce it, and the armoured lower section of the mast (conning tower) on which it sits. In addition, the support for the binnacle has to be

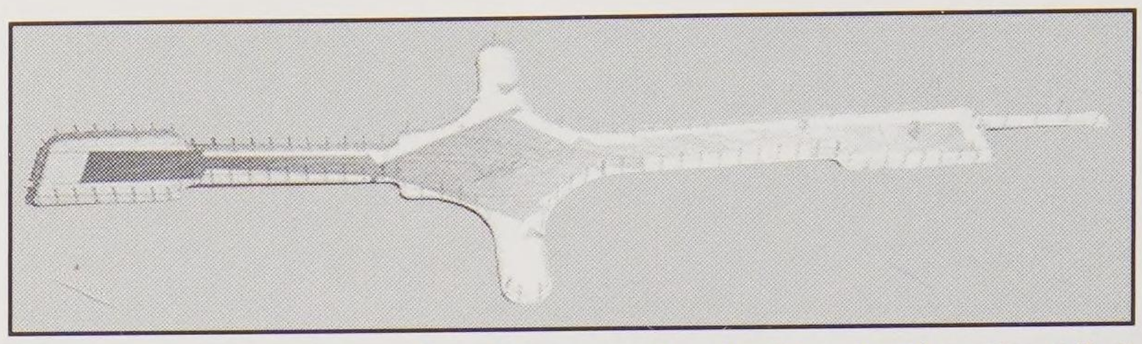


FIG. 3-22: Capping rail with guardrails fitted. The "inside" of the capping rail was left in for stability.

fitted at the extreme aft end. This support was made in two telescoping pieces to cater for height adjustment at this point.

Guardrails

Before finally fitting the flying deck, the guardrail fixing holes must be drilled. Guardrails were etched and had a wooden capping rail. Joining bits of flimsy wood guardrail can be tricky and, unless superbly done, exhibit every fault to all and sundry. Stuck up in the air as they are, they draw unwelcome attention to themselves. The problem is further exacerbated by their complex plan shape – 18 curves of various sizes around which to navigate.

I spent much thought on this, after seeing how others tried to solve the problem. I finally decided to cut the whole capping rail in one piece from 0.5mm plywood sheet and hang the expense. This would eliminate the joint problem, and the shape could be made as a template.

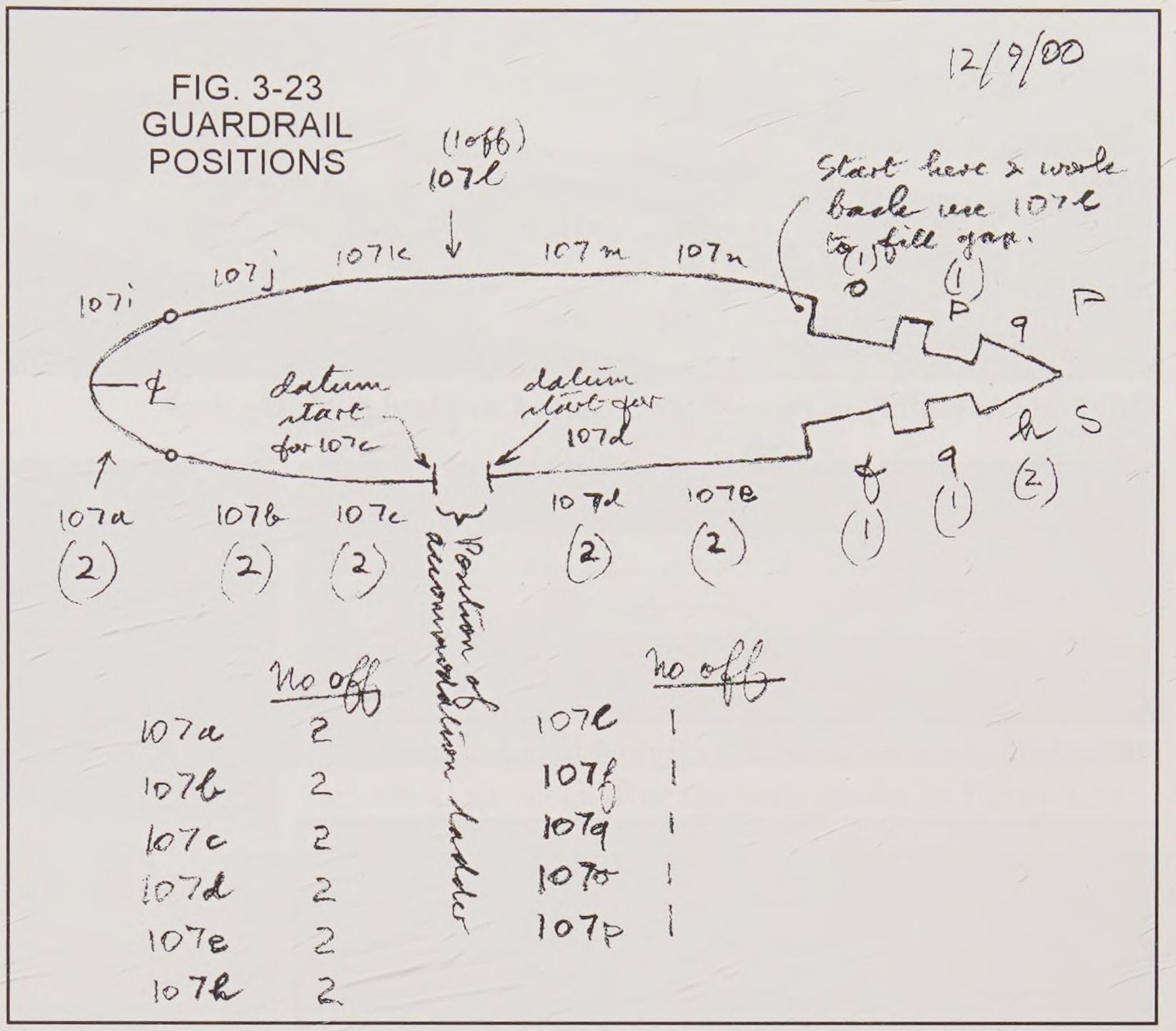
The flying deck was laid onto the plywood and marked around with a sharp pencil. To show the pencil line more clearly, the surface of the plywood was covered with self-adhesive sticky paper labels (**Fig. 3-22**). Care was used to ensure the plywood's best face ended up as the topside of the capping rail. Only the capping rail's outside shape was cut. The interior was left in at this stage to provide stability. Experience with using templates teaches one that the "copy" always comes out a trifle larger than the original. This could be a disaster, so the plywood shape was clipped onto the flying deck and the edges taken back to a close fit where necessary.

The etching sketches were then brought out to see where the etched railing parts fitted. These sketches, prepared prior to drawing the actual etching drawings, establish stanchion spacings and show where the joints are. It is also essential to establish any datums. For example, guardrails must fit around a fixed ladder, fairleads, bollard,

or anything else in the way. You cannot have a stanchion in the middle of a fairlead. So, the initial sketches are of the greatest importance and should be perused carefully before embarking on any practical work.

To ensure a neat joining job, the end stanchions of each joining piece were etched to half thickness so, upon assembly, these became a full thickness stanchion. Obviously, one end was half etched from the back and the other from the front to make a matching pair. It is absolutely necessary to locate which etched piece goes where and to identify the correct etched pieces; hence, the etching sketches. This sounds obvious, but in practice it needs care.

Fig. 3-23 is a rough diagram of each guardrail's etching section. This is essential, as just looking at the etching or etching diagram gives no clue as to where the pieces go on the model. This sketch refers only to the main deck's guardrails. A similar diagram for the flying deck is more complicated and, at first glance, totally mystifying even to the writer!



Drilling for the stanchions

The etched pieces were offered up in their correct position and holes drilled for the stanchions. This seemingly simple operation re- quires great care. Matching the holes with the etching is not easy. Misplaced holes – and you will get them – must be filled with Isopon and redrilled. Do not drill the holes too to close a fit. A degree of slackness is essential for assembly.

After drilling the holes, transfer them to the flying deck using the plywood as a template. This will ensure geometric accuracy with each pair of holes truly vertical. Most railings around the flying deck were the single ball type, but I added a thin extra bar to the top for strength. This was hidden by the capping rail. Stanchions had top and bottom fixing spigots. The guardrail on the extension to the binnacle at the aft end had only the top strengthening piece I added and no horizontal rail. Now the plywood's interior could be cut out to produce the thin capping rail. A delicate and not to be rushed job, but if well done, most rewarding.

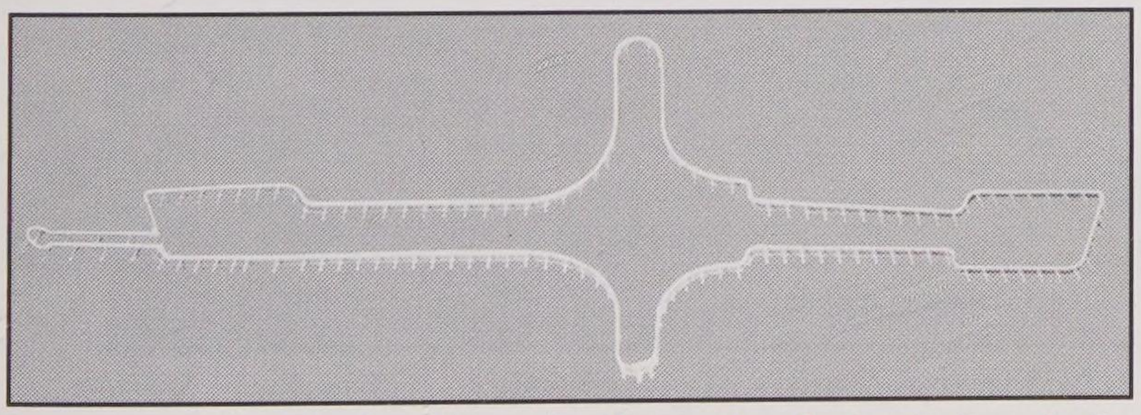
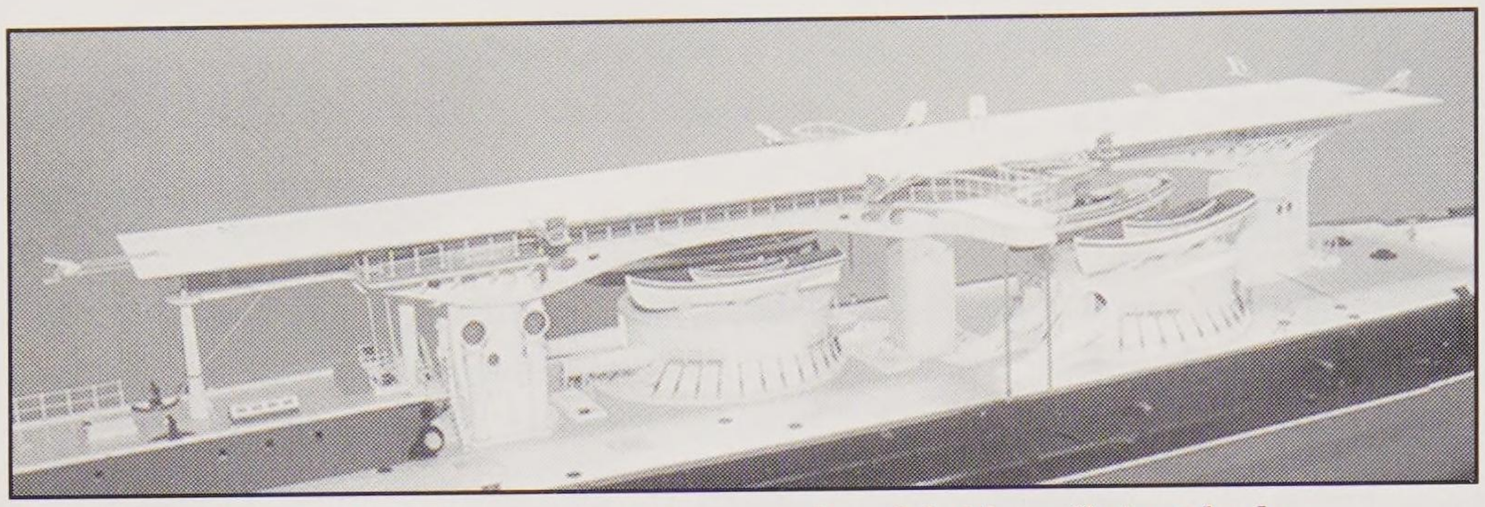


FIG. 3-24: Finished and sprayed guardrails for flying deck. Wood capping rail was painted brown after assembly with flying deck.

Guardrail assembly

Assembly needed some thought. There were two possibilities. One was to fix the etched railings to the flying deck first. This meant trying to attach a flimsy, frail, unsupported wood rail to about 100 stanchions. The other way was to invert the capping rail and attach the etched stanchions to it first. At least the capping rail could be supported on a flat surface whilst doing so. This seemed the best way. The assembly was sprayed white (**Fig. 3-24**), then temporarily clipped to a balsa sheet (**Fig. 3-25**), the whole unit inverted, and laid on the flying deck (**Fig. 3-26**).



FIG; 3-26: Assembly of Figure 3-25 inverted and laid on flying deck,

To finally assemble the guardrails, the lower stanchion ends must be fitted into the predrilled holes in the flying deck (**Fig. 3-27** and **Fig. 3-28**. The capping rail could then be painted brown. Before assembly, I painted its underside brown, as it was more convenient to do so with it inverted.

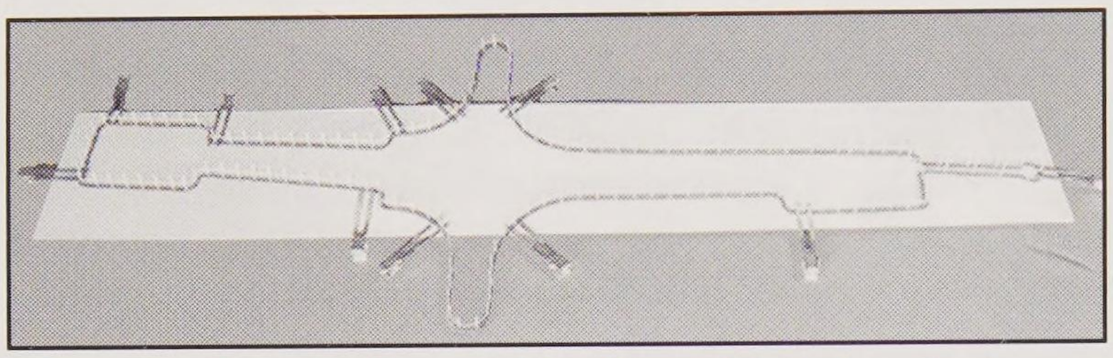


FIG. 3-25: Guardrail assembly clipped to balsa sheet.

FIG; 3-27: The balsa sheet has been removed and the author is guiding the lower ends of the stanchions into their predrilled holes. Rear stanchions have been located and clipped.

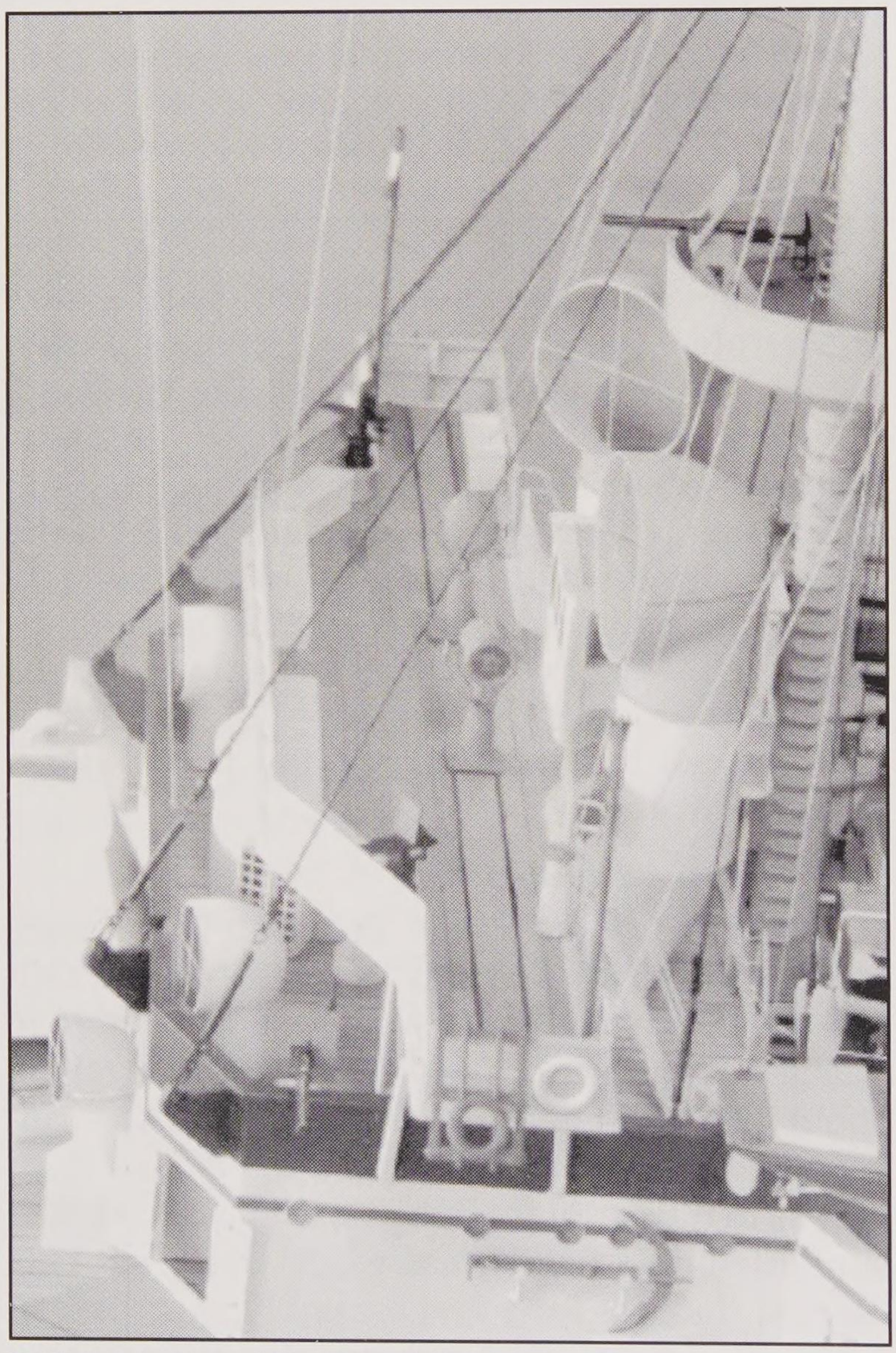


FIG. 3-31: *Magnificent's* aft bridge deck.

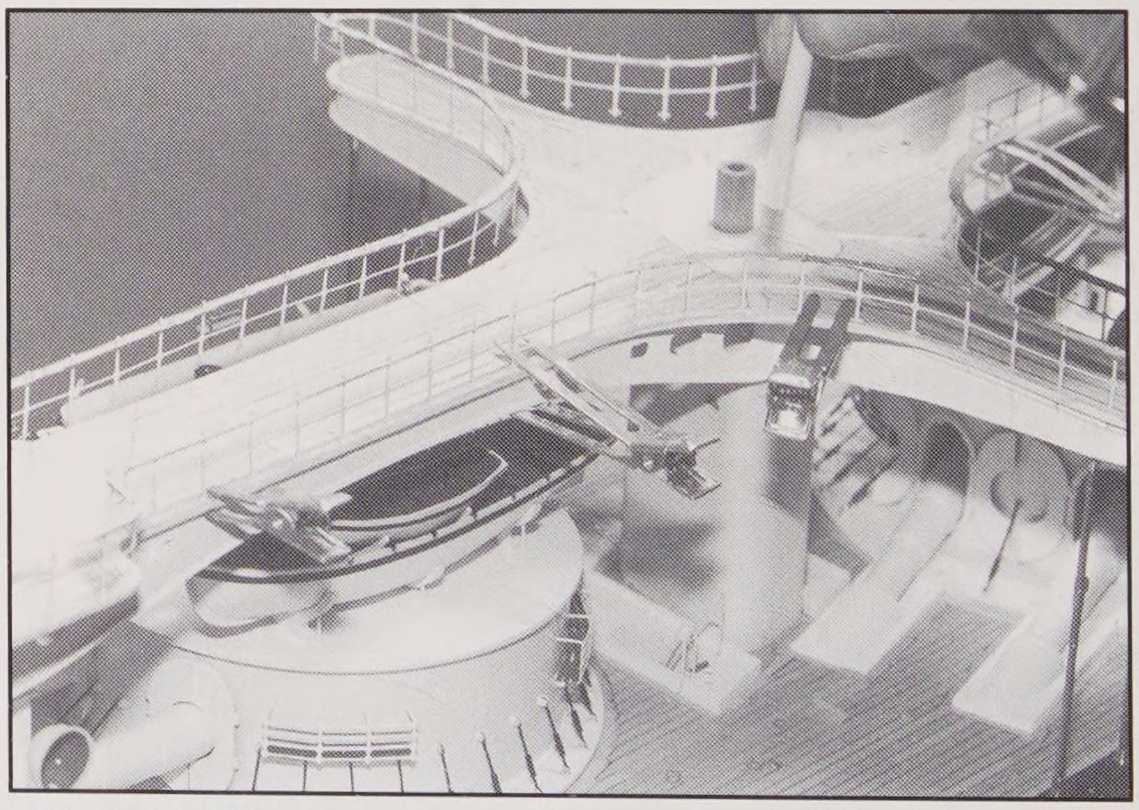


FIG. 3-28: Final assembly of guardrails to flying deck. Note the use of hair clips to clamp the assembly.

Spar deck and bridges

Spar decks, often a feature of Victorian battleships, were minimal structures for supporting ship's boats. Their minimalist structure saved weight at this height from the deck. Any planking was limited, again for weight reasons. **Fig. 3-29** shows *Victoria's* spar deck being constructed over the battery deck (**Fig. 3-14**). *Duilio* had no spar deck.

Victorian ships often have command bridges set transversely across the hull with only the centre being solidly supported. The extreme ends will have pillar supports, but the rest is up in the air. **Fig. 3-30** shows how *Magnificent's* bridge wings were supported.

Making these can be a problem. Planking runs are not fore and aft as are the decks, but athwartships (**Fig. 3-31**). If you are going to plank the bridge wings, their undersides must be similarly balanced with veneer. They do not need to be individually planked, but they must be balanced.

Fig. 3-32 shows a completely different kind of bridge, that of *Victoria*. The shape of the superstructure's fore end was dictated by the fore turret's arc of fire.

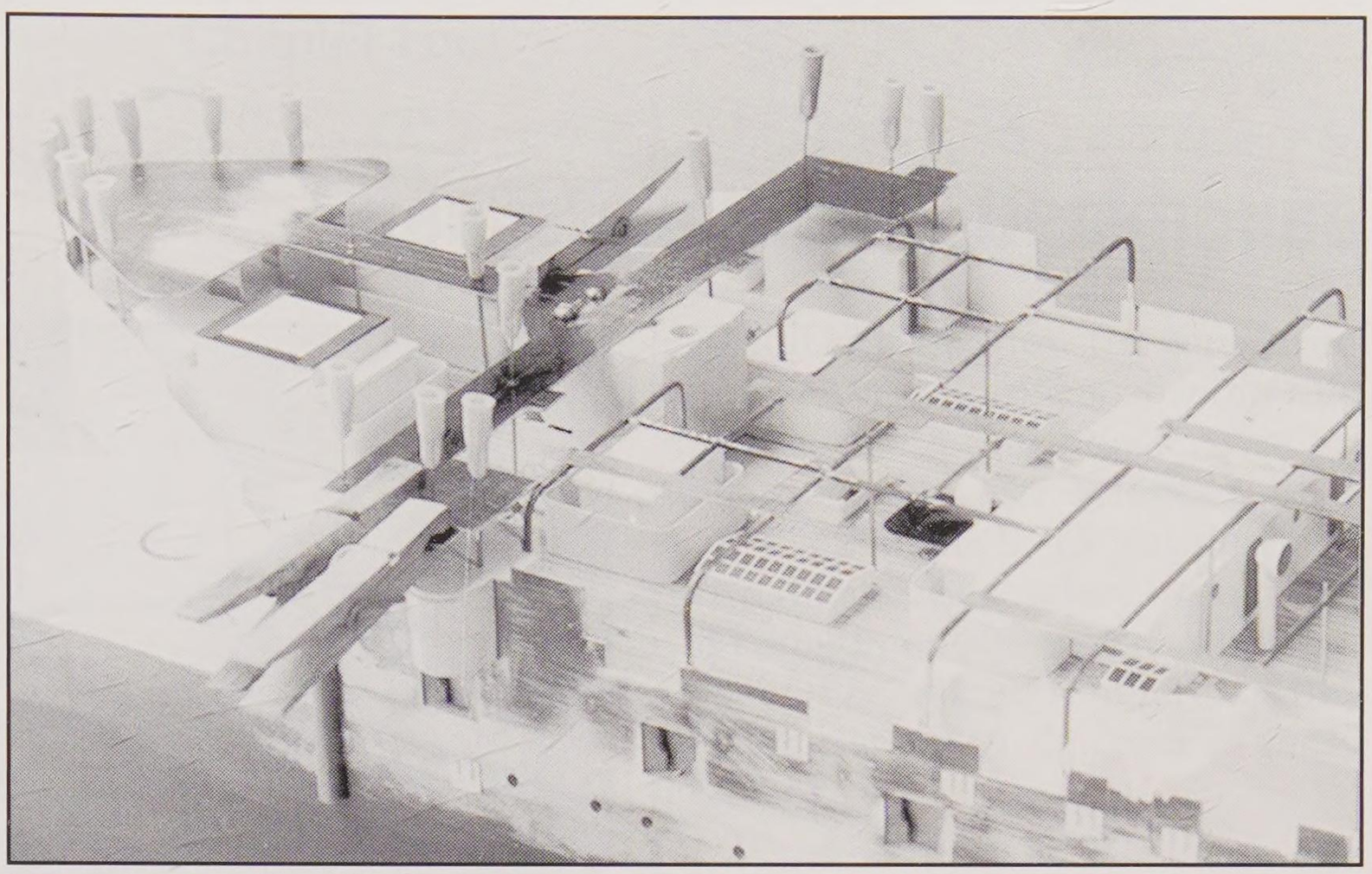


FIG. 3-29: Constructing *Victoria's* spar deck over the deck shown in Figure 3.14

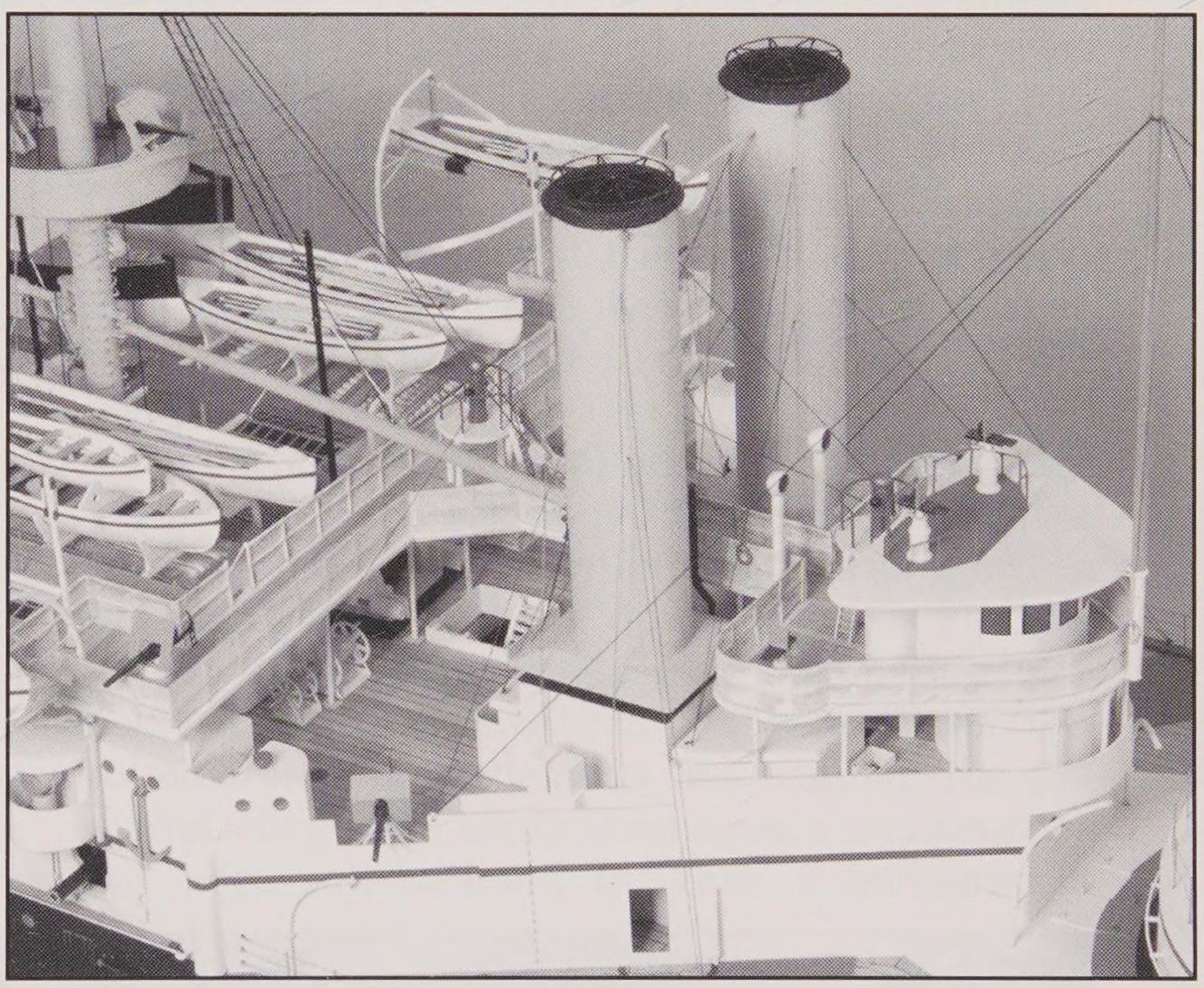


FIG. 3-32: Bridge on *Victoria*.

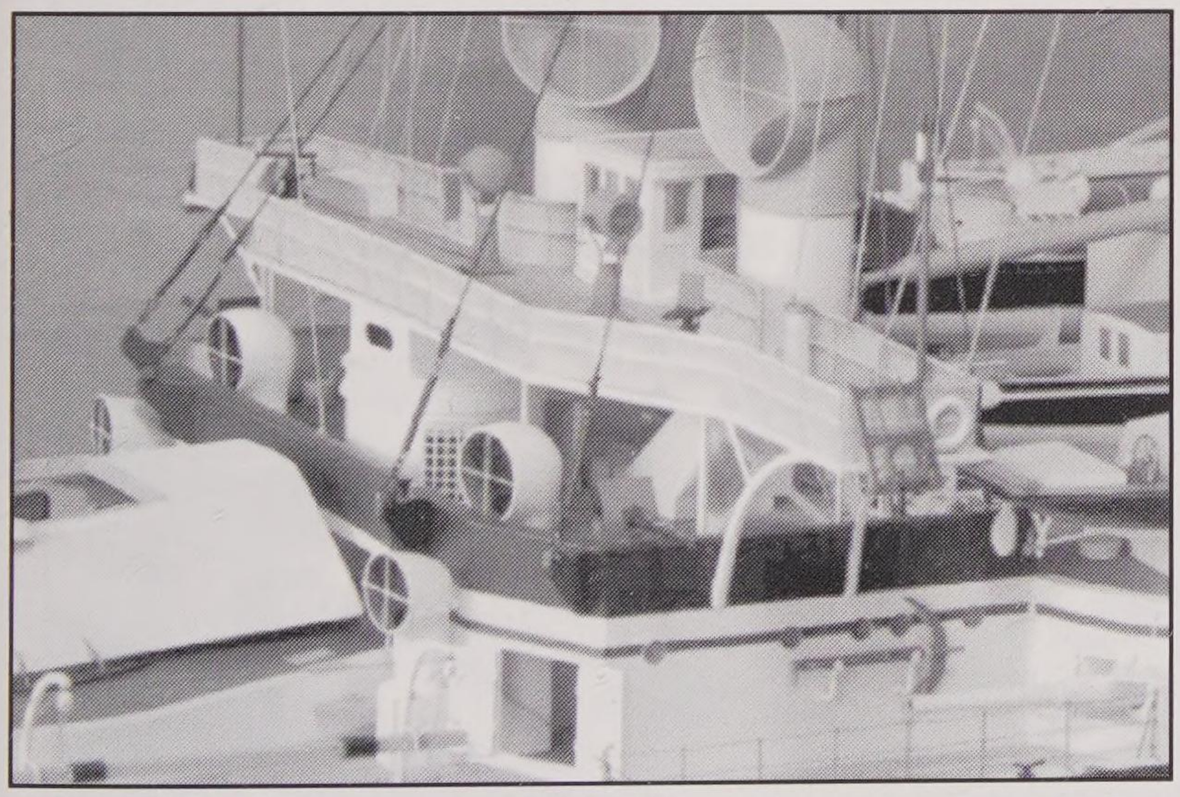
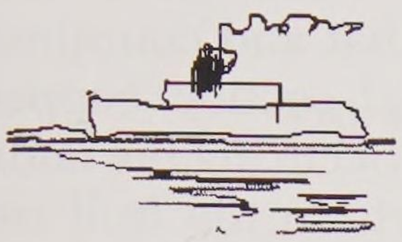


FIG. 3-30: How *Magnificent's* bridge wings are supported.



Chapter Four

Superstructure & Deckhouse

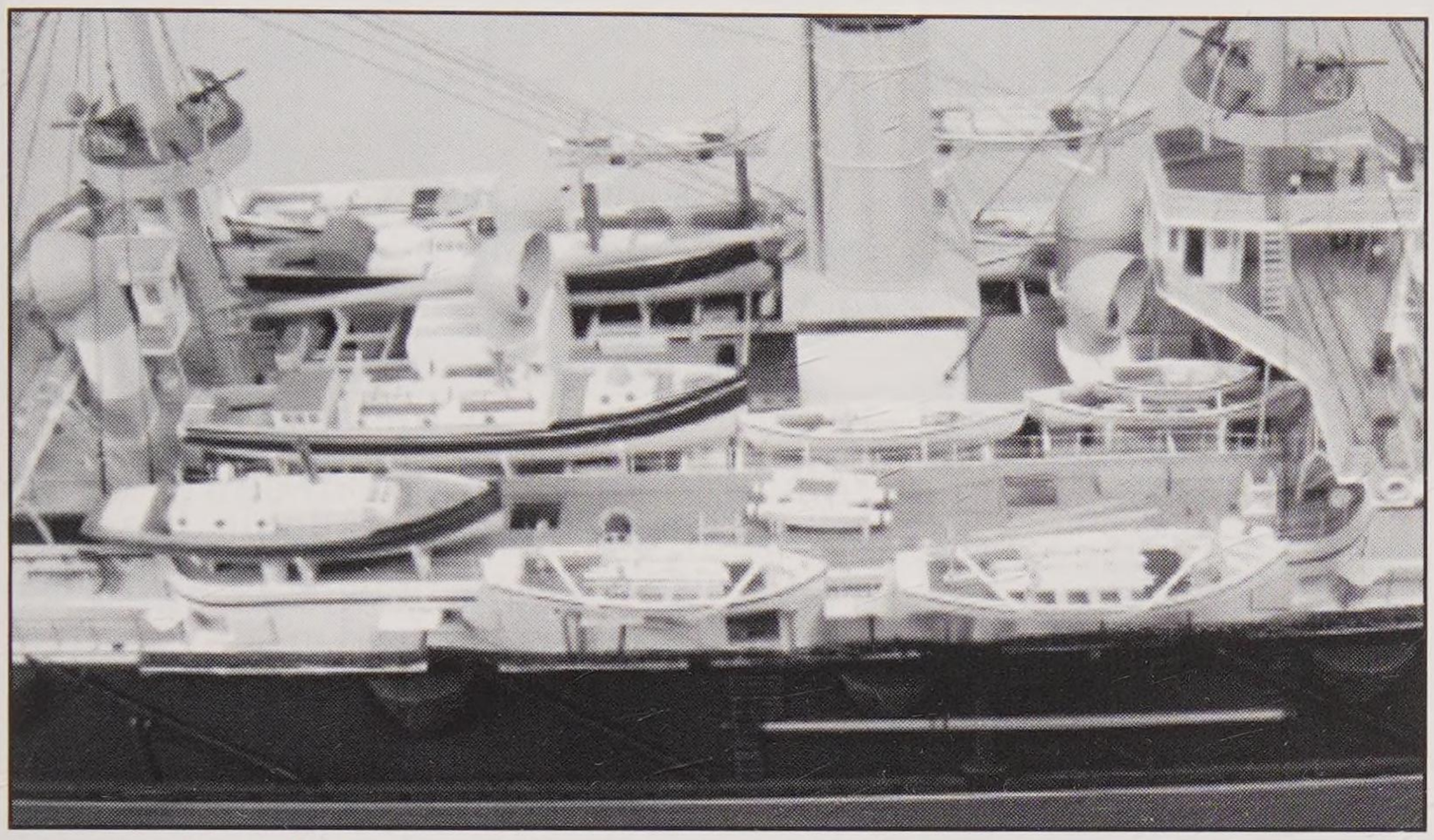


FIG. 4-2: Spar deck on *Magnificent*.

Pre 1870 when the Royal Navy was still using sails, the layout of a ship's superstructure was mainly like sailing ships of the period with guns lining the bulwarks similar to vessels of the Trafalgar era. After 1870, with the use of sails declining, things changed. Obviously the gun positions were paramount with the superstructure arranged around them. Two distinct arrangements can be seen throughout the period under review.

If the guns were mounted fore and aft, the main arrangement was to place the superstructure in the ship's waist with the main bridge sited at the front and a subsidiary bridge at the rear. **Fig. 4-1** (c/s) and **Fig. 4-2** show the general arrangement on *Empress of India* and *Magnificent*. A gun deck was arranged between the bridges with a spar deck over it to support the ship's boats. Secondary armament was sometimes casemated as in *Magnificent* (**Fig. 4-3**) and sometimes turret mounted as in *Empress of India* (**Fig. 4-4**).

Bridges

The bridges at this time were simple structures, nothing like the bridges on 20th century dreadnoughts. **Fig. 4-5** (c/s) shows *Victoria's* enclosed bridge, which was atypical because of the rest of the superstructure's arrangement. However, the aft bridge was typical (**Fig. 4-6**) as was the fore bridge on *Empress of India* (**Fig. 4-7** c/s).

With *Victoria* (**Fig. 4-8**) and *Sans Pareil* (sister ship), the spar deck above the gun deck was a complicated structure with the beams supporting the ship's boats curving down to act as vertical supports. **Fig. 4-9** shows the arrangement under construction. These would have been "I" section rolled iron/steel girders on the original. For the model, they were made from square section copper wire soft-soldered together. I borrowed a

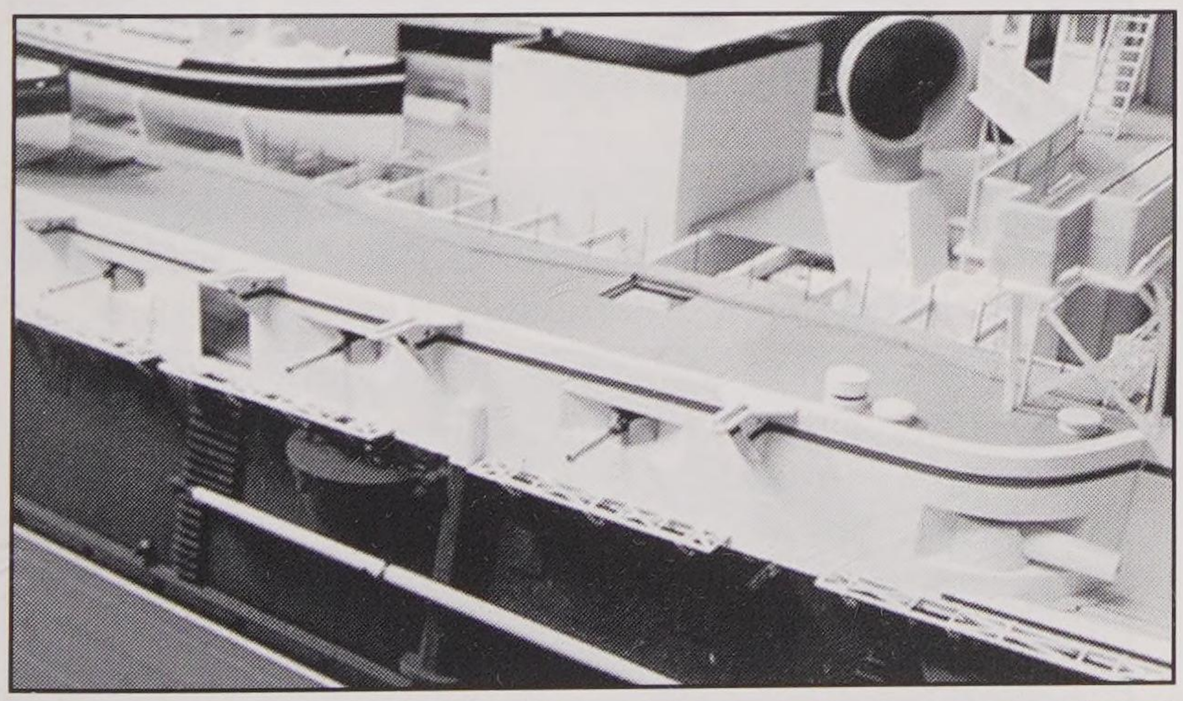


FIG. 4-3: Casemated secondary armament on uncompleted model of *Magnificent*.

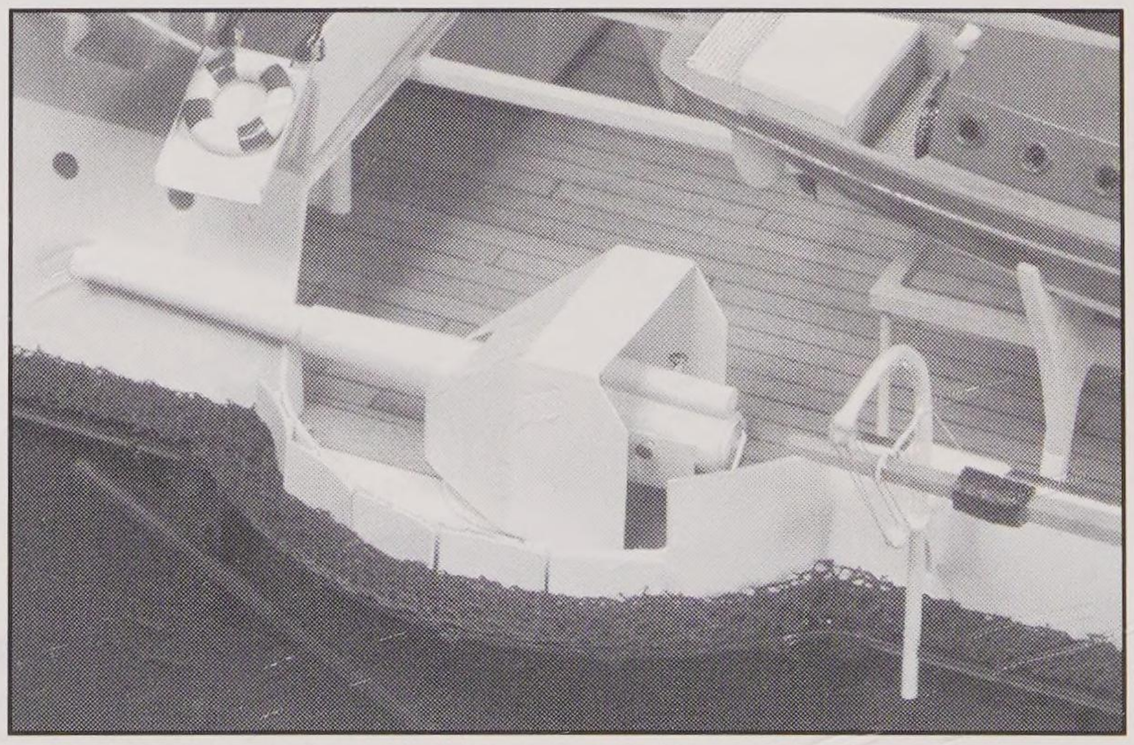


FIG. 4-4: *Empress of India's* secondary armament.

FIG. 4-6: *Victoria's* aft bridge.

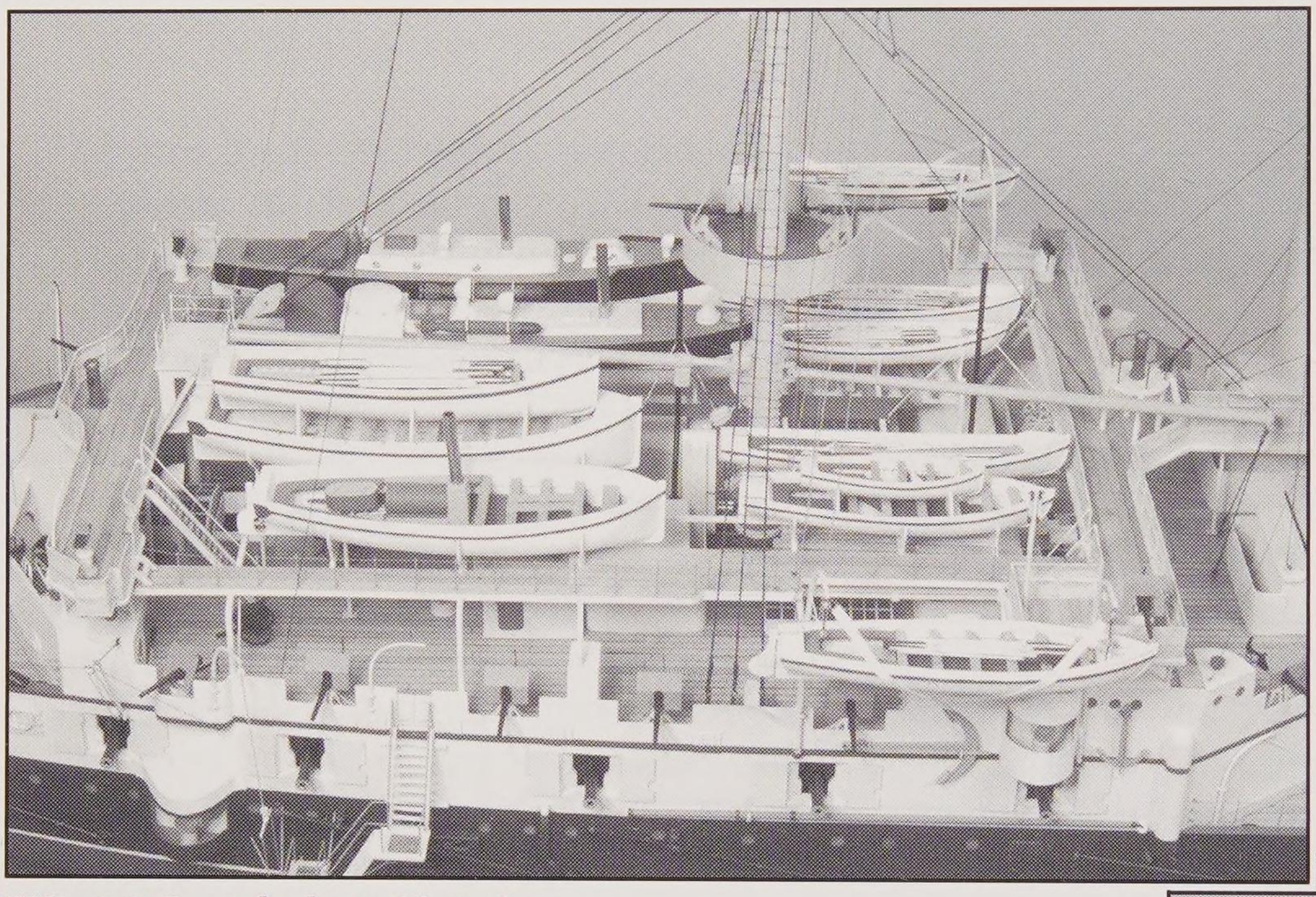


FIG. 4-8: Spar deck on *Victoria*.

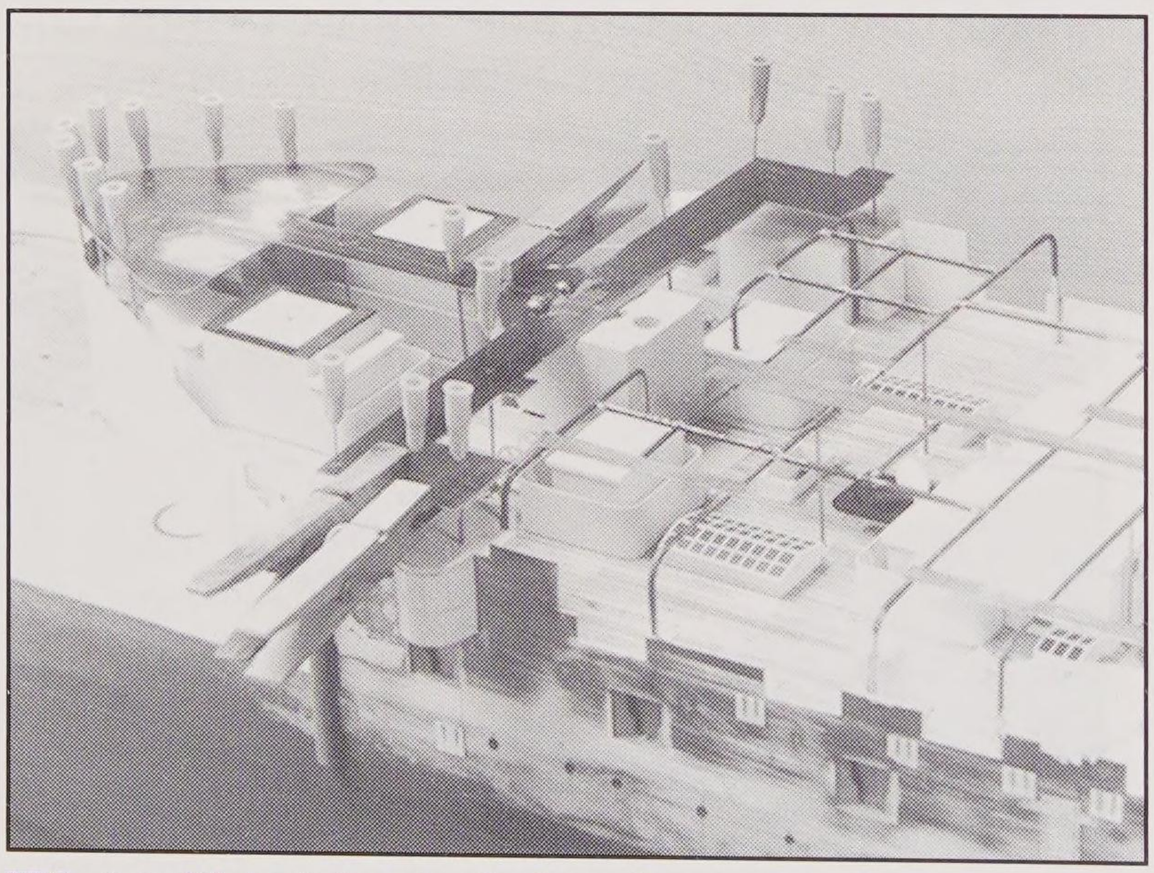


FIG. 4-9: *Victoria's* spar deck under construction.

square-hole drawplate and made the square section using that and countless annealings from round section copper wire. Not an easy job. Securing the ends of the vertical supports to the hull required some care and thought. The secret was to get everything absolutely geometrically accurate. As you can see from **Fig. 4-8**, it needed to be.

This arrangement was due to the armament's peculiarities with two 16.25-inch guns forward and the main superstructure set back supporting the single 10-inch weapon at the rear (**Fig. 4-10**). This deck could have been constructed using commercially available brass or plastic structural sections, although plastic would have been frail.

The other main configuration was when the guns were arranged en echelon as on *Inflexible* (**Fig. 4-11**) and *Duilio* (**Fig. 4-12**). Here the classic arrangement was a large deckhouse aft (rather like a clipper ship) with a flying deck connecting the funnels and mast. As said in chapter one, this arrangement, which nominally allowed a four-gun broadside, was unsuccessful and therefore, short-lived; however, it makes for an interesting model.

A couple of further points is that Victorian photography tends to let one

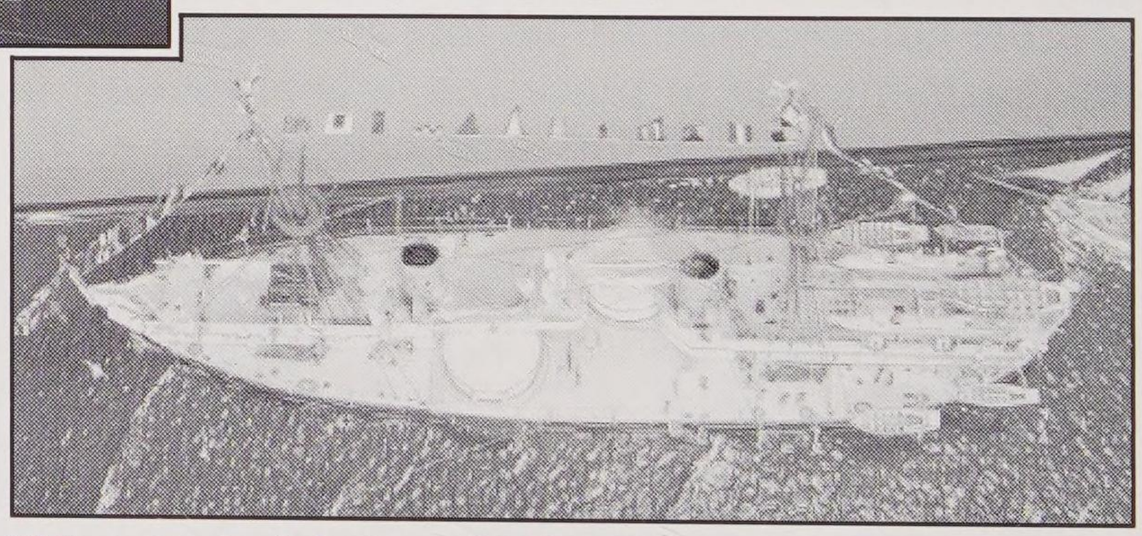


FIG. 4-11: Aerial view of *Inflexible*.

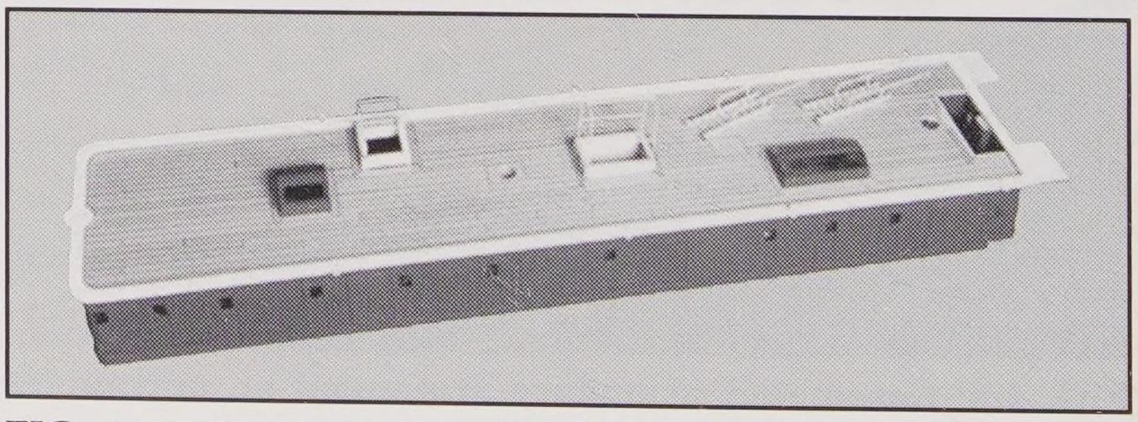
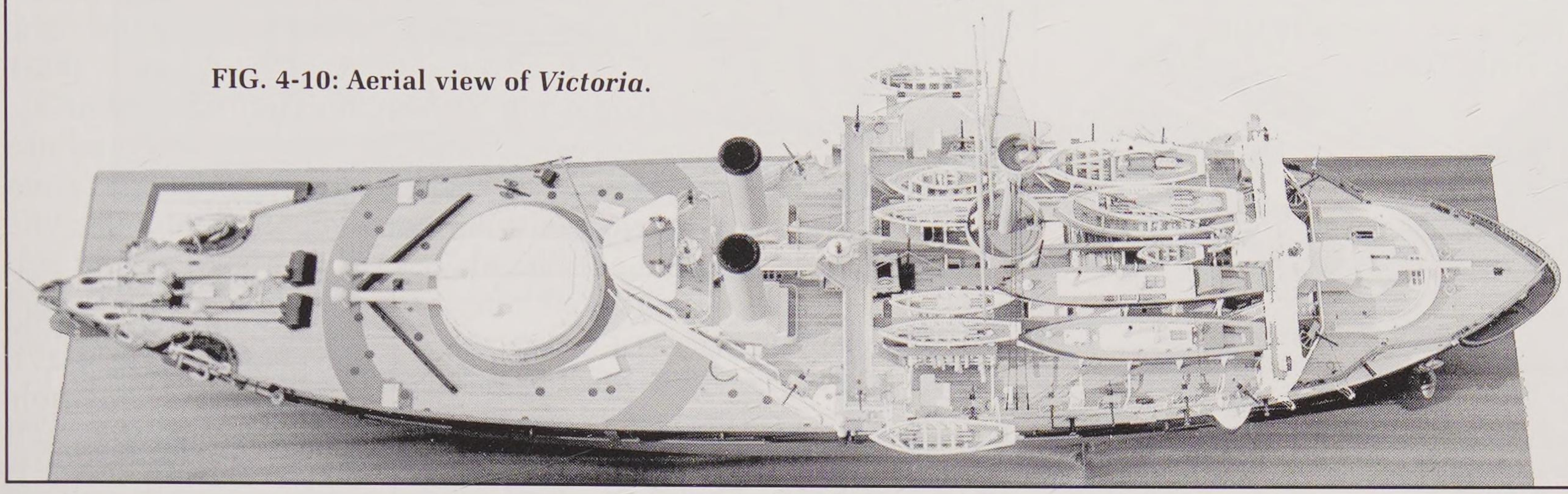


FIG. 4-13: General view of *Duilio's* deckhouse.

FIG. 4-10: Aerial view of *Victoria*.



down. While there are plenty of photos showing the forecastle and quarterdeck, those of the ship's waist are in short supply. One great source of pictures for this period is the bound copies of *Navy and Army Illustrated*. Although from the 1890s, they are still obtainable, secondhand of course. I found Vol.1, 1896 to be the most useful. My copy, rebound by a friend because it fell apart through use, was my grandfather's, and it has become one of my most treasured possessions. The captions are rather naive in some cases, but the pictures provide a mine of information. This volume seems to show more ships and onboard shots than any other I have seen.

Deckhouse

Duilio, with its large deckhouse mounted at the rear of the main deck, typifies the construction of a ship carrying its main armament en echelon (**Fig. 4-13**). The deckhouse, and others of this basic design, commands respect, as visually it dominates the quarterdeck. At a guess, it was clad with vertical mahogany planking vee jointed, which was standard Victorian practice – square ports and doors. It also supports the eight inboard boat davits.

It was decided to clad the vertical surfaces with brass etchings, as these could carry the half-etched lines representing plank joints, door frames, and the to-be-glazed square port openings. Half depth etching also was used to "panel" the doors. An unfortunate error crept in here as the deckhouse's detailed drawing was 3 to 4mm longer than that shown on the general arrangement. As the component was made to the detail drawing, its extra length caused much trouble on final assembly. A

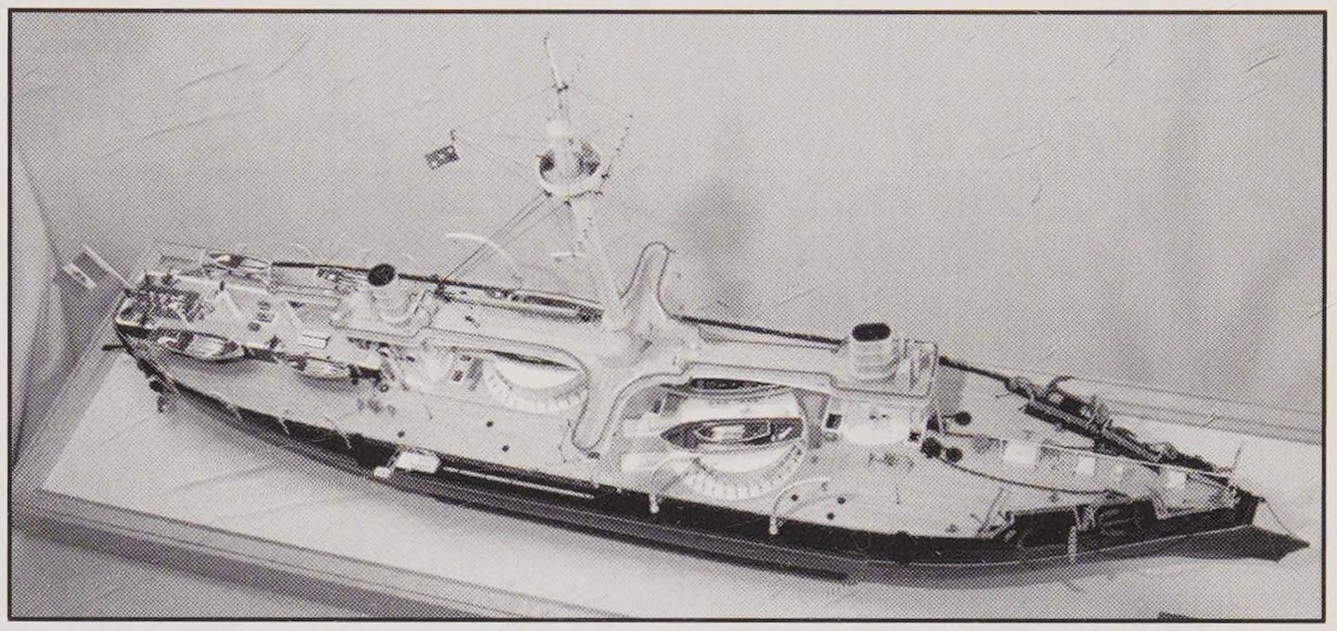


FIG. 4-12: Aerial view of *Duilio*.

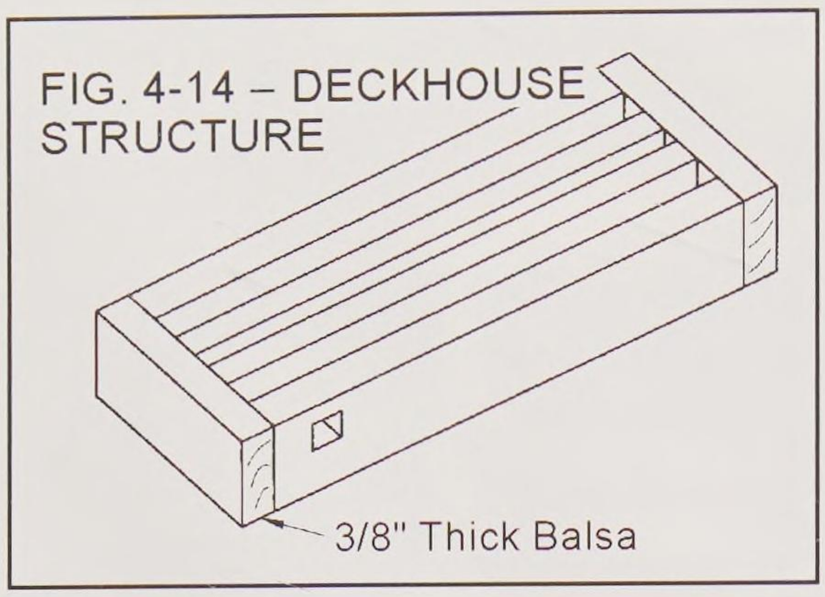
bit of juggling was required to get everything in.

As the etchings had to accommodate the deck sheer which rises at the stern, each side was different. All the verticals had to be vertical and not perpendicular to the lower edge. Owing to size limitations, each side could not be made in one piece, as would have been desirable. The position of doors and ports was determined first and the space filled with planking. At the rear, the corners were radiused (in plan) and the correct developed length allowed for.

Structure

Obviously a structure was needed on which the cladding could be fixed and the deck head supported. This was made from 10mm thick balsa (**Fig. 4-14**), because a large number of square openings had to be cut into the sides. On reflection this was a mistake. Jelutong would have been better and the more difficult task of cutting in the square openings faced up to. Balsa is really too soft for high-class modelmaking.

The top of this structure was a piece of 6.3mm (¼") 3 plywood, which acted as a false deck for



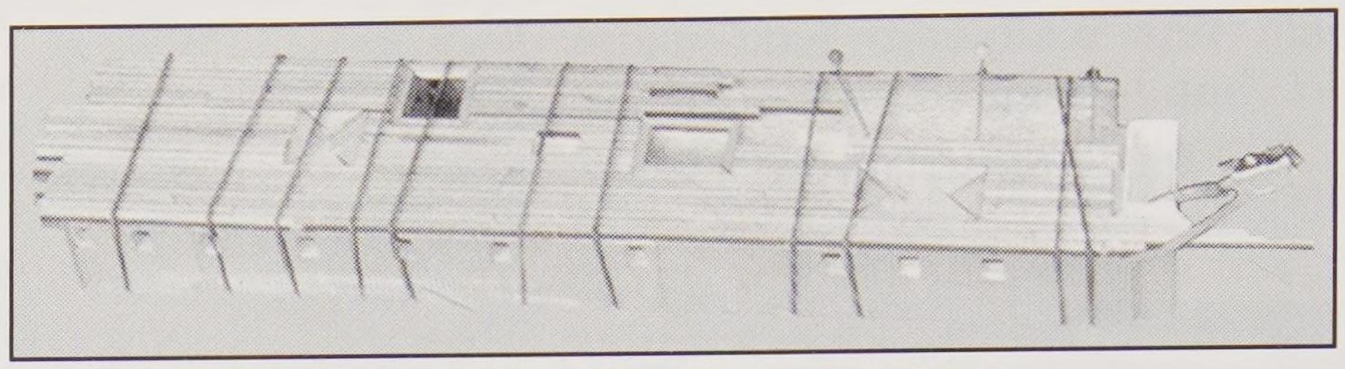
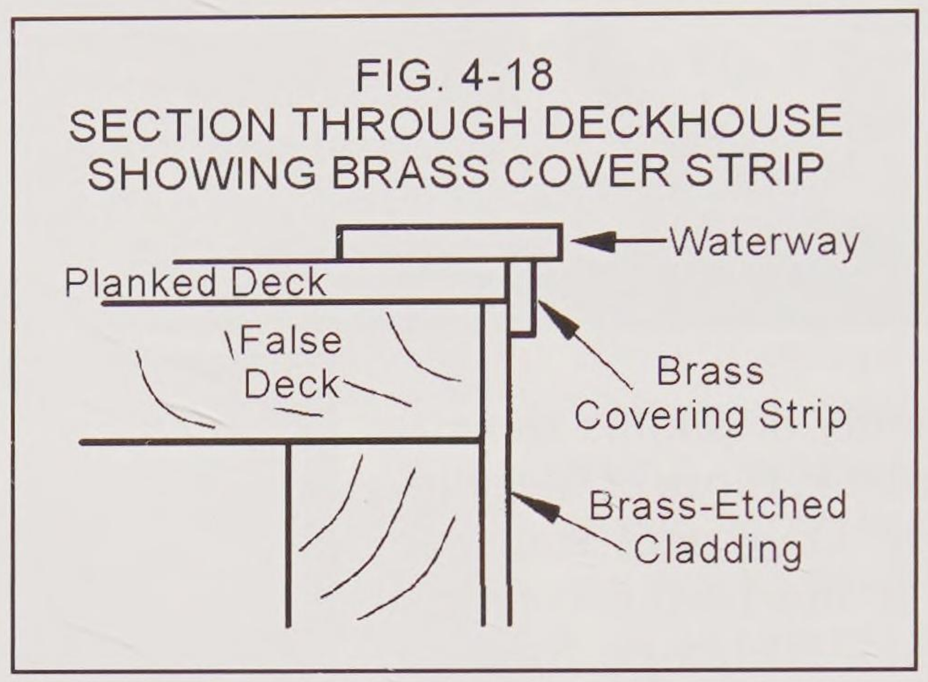


FIG. 4-15: Deckhouse roughly planked and cladded.



subsequent plank laying. This planking, laid as on the main deck, stood proud of the cladding so its surface and edges could be cleaned up (**Fig. 4-15**). Two companionways and various skylights required margins and these were done first. A "vestibule" at the fore end is shown in **Fig. 4-16**, as are the white plasticard linings. If possible, do not leave faces of wood that are difficult to get at and sand. Always line them with metal or plastic; it makes painting them so much easier. Two platforms and their associated ladders were fitted at the fore end. **Fig. 4-13** shows the platforms fitted and the etched ladders lying on top. All these parts were etched in brass.

Before the cladding was finally fixed, the position of all square openings was marked off and cut out using a drill first, then shaping with a No. 26 scalpel blade. As these were to be glazed later, a recess was cut wider than the opening and extended from top to bottom. Its depth would allow the clear glazing acetate to slide in behind the cladding (**Fig. 4-17**).

The recess and hole were then painted matt black. During the rest of the construction, they were filled with strips of card to avoid overspray from getting inside. The acetates were fitted just before the deckhouse was screwed to the main deck.

The deck was finished off with a raised edge to form a waterway (**Fig. 4-13**). This projected slightly over the edge and was cut in one piece from ABS. A strip of brass was fitted to cover up the edge of the planking (**Fig. 4-18**).

Deck winch

Fig. 4-19 shows a general view of the winch and **Fig. 4-20** shows the winch in situ.

Situated at the fore end of the deckhouse, it looks very complicated at first. (Because drawing conventions differ between nations, the realisation of the winch was handicapped by some views not being in the projected position as English draughtsmen would draw them.) Basically, the winch consists of a horizontal shaft with capstan chain wheels and rope drums at both ends; the whole being driven by a double acting twin cylinder steam engine with a four pinion compound gear train to increase torque and the necessary slow speed to the working shaft. **Fig. 4-21** (c/s) to **Fig. 4-23** show the

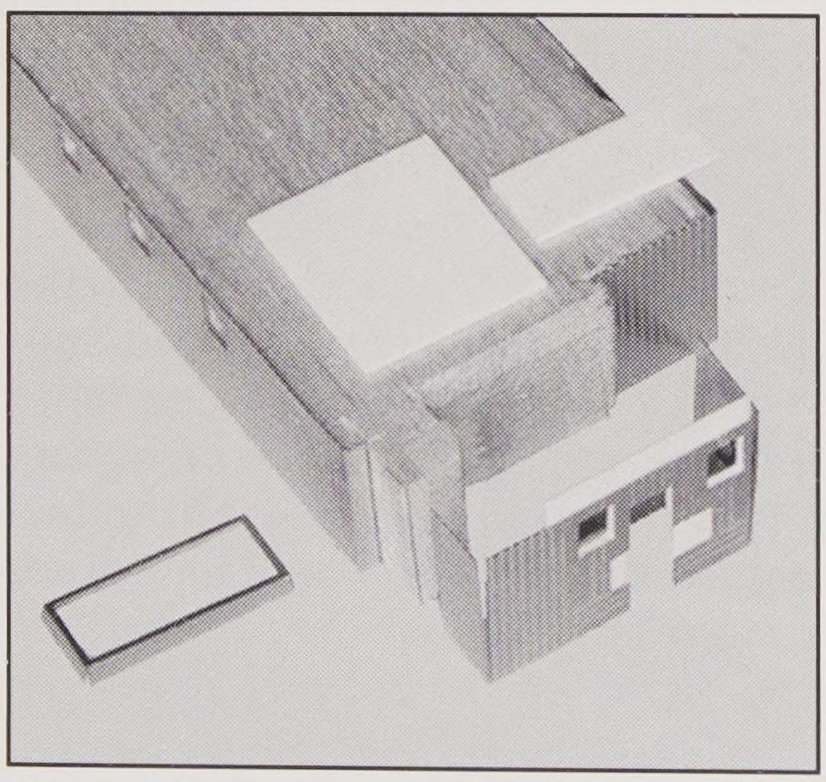
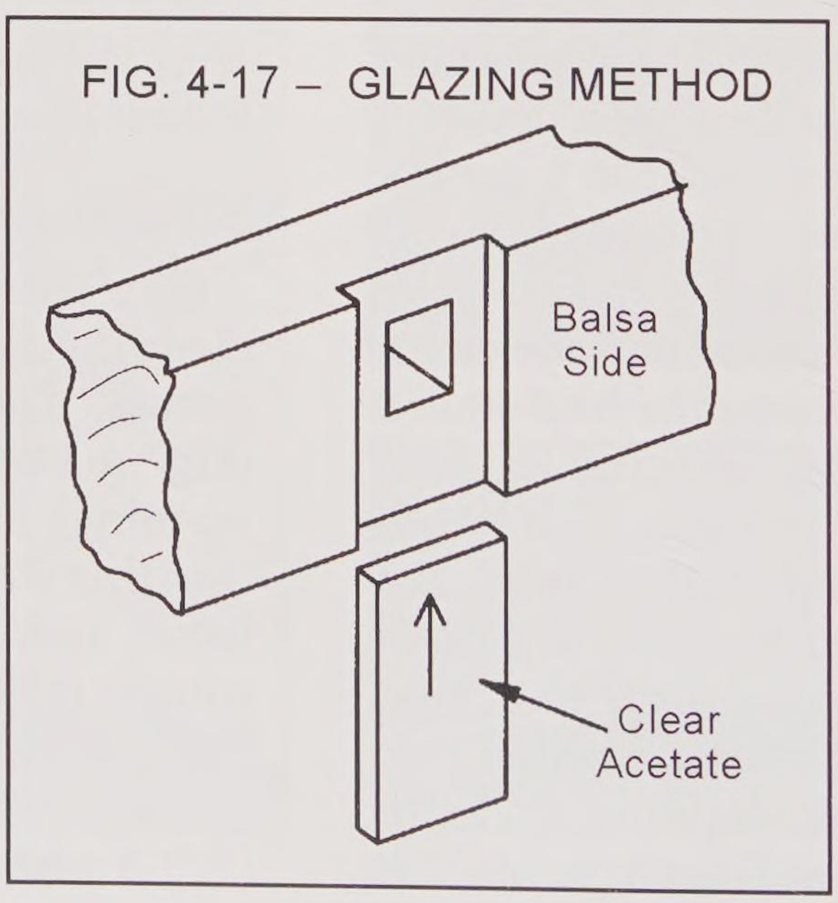


FIG. 4-16: Fore end of deckhouse showing vestibule and white plasticard linings.



winch under construction. A manually operated dog clutch allows either end to be selected (**Fig. 4-24**).

Careful examination reveals the whole setup can be reduced to simple components, of which most can be turned. Unlike winches that are usually self-contained and stand on their own base, this unit is fixed to a deck plate and the forward face of the deckhouse, so it cannot be made completely off the model.

The only difficult pieces to make were the two central cheeks of the winch heads, which are scooped out to accommodate the chain links. The outside diameter of the whole could be simply turned. Then the chuck holding the turned component was transferred to the rotary table mounted horizontally on the vertical mill, and a slot drill used to machine out the scoops (**Fig. 4-25**). A sufficient length was prepared so the four components could be parted off when the chuck was returned to the lathe. (My rotary table accepts Myford chucks, which enable turning and milling operations to be done without removing the work from the chuck).

Five scoops were required, which necessitated indexing 72°. The table was centra-

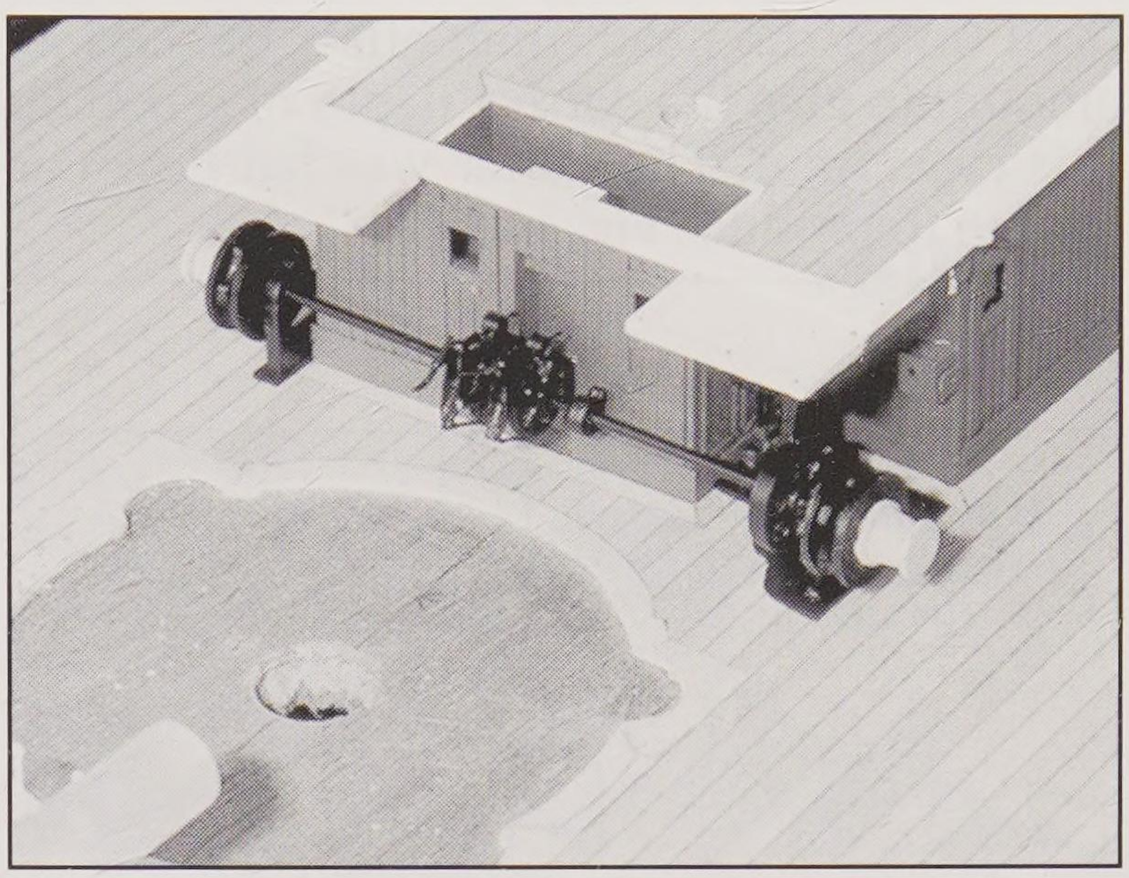


FIG. 4-20: Painted winch to fore side of deckhouse.

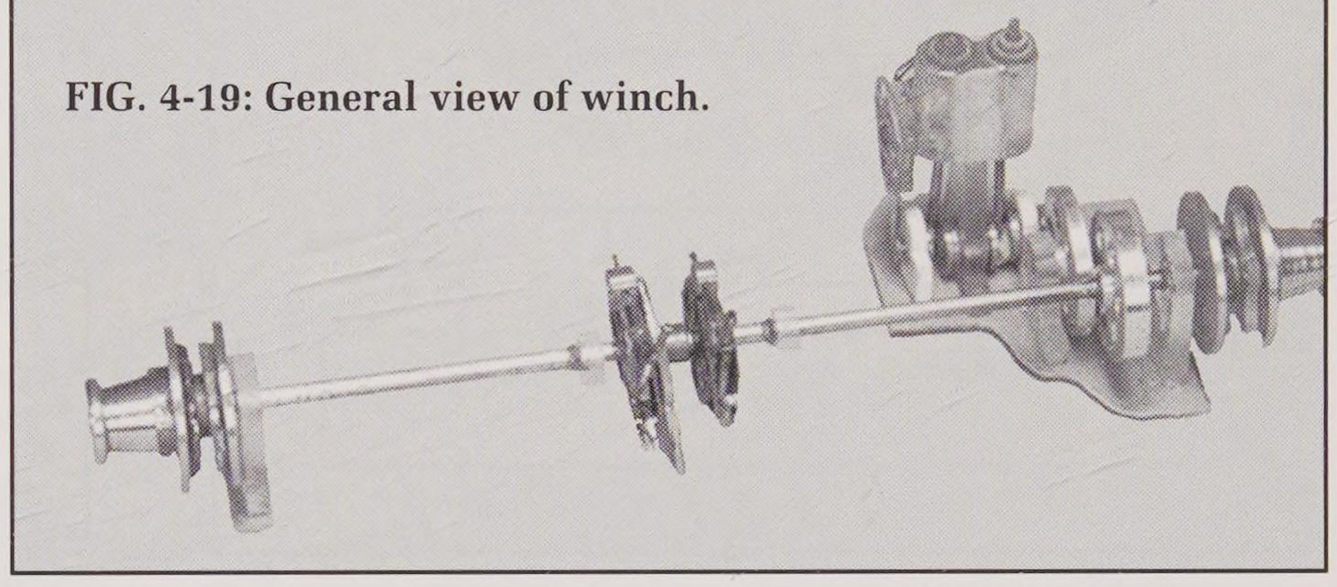


FIG. 4-19: General view of winch.

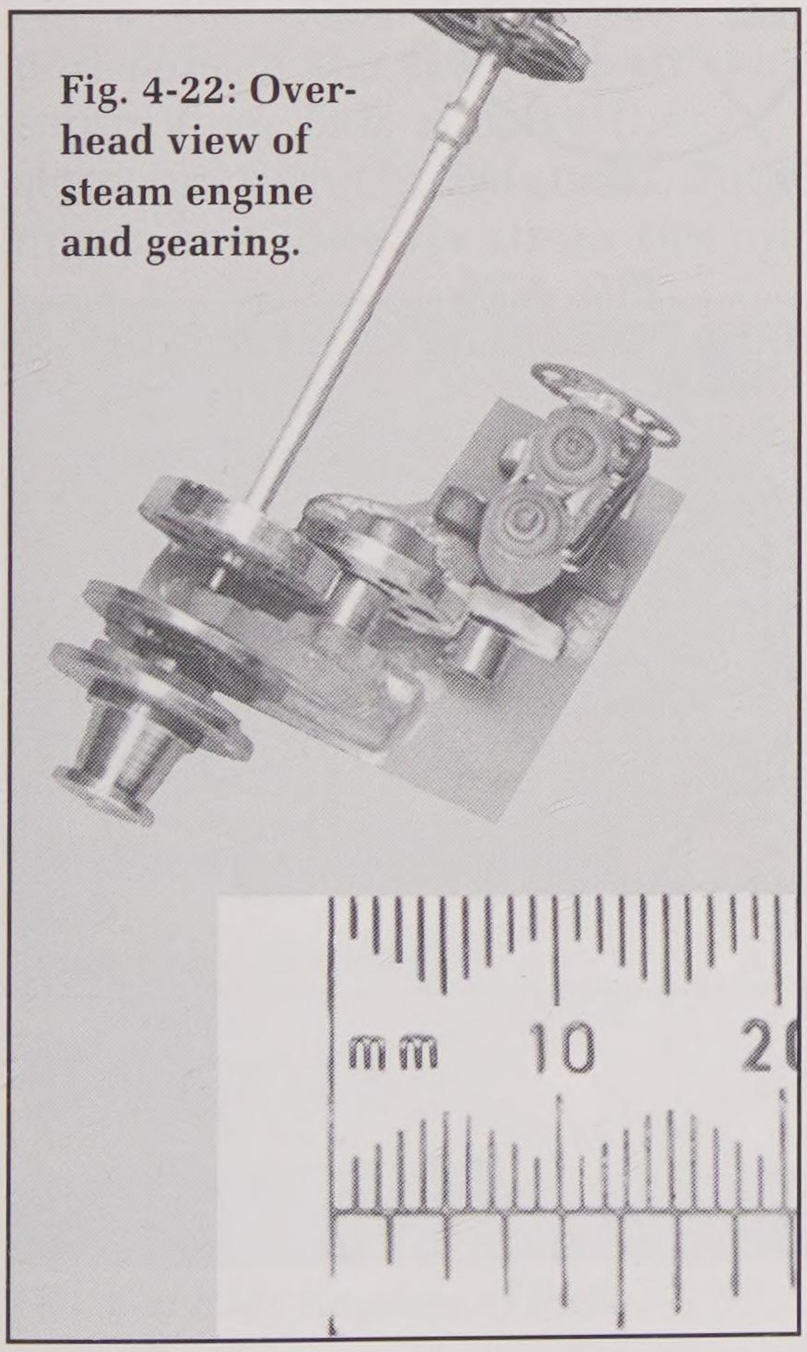


Fig. 4-22: Overhead view of steam engine and gearing.

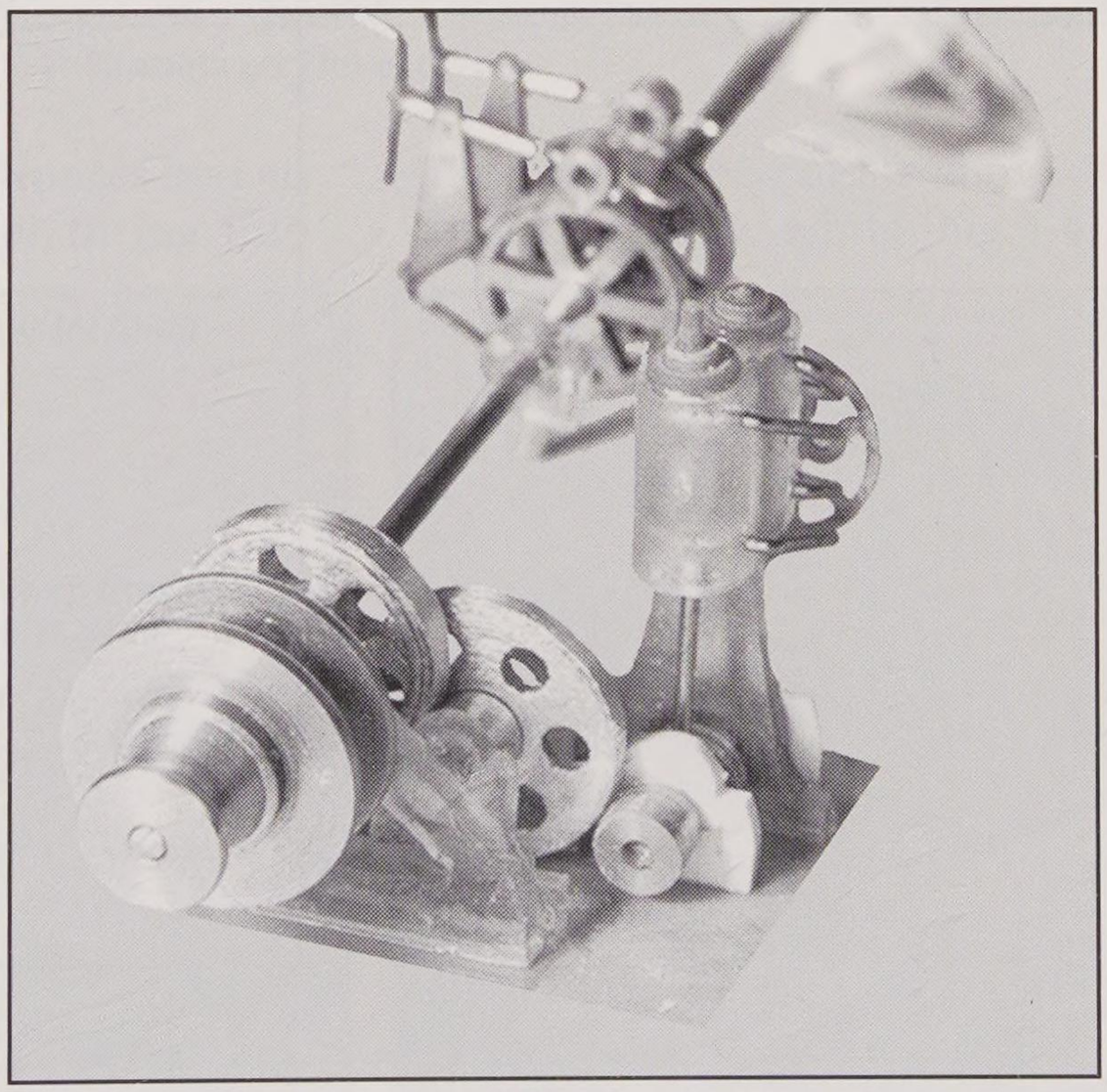


FIG. 4-23: Another view of the unpainted steam engine.

lised under the head, then offset the correct amount to give the correct depth of scoop, in this case 1mm. The cutter was fed down as shown to produce **Fig. 4-26**.

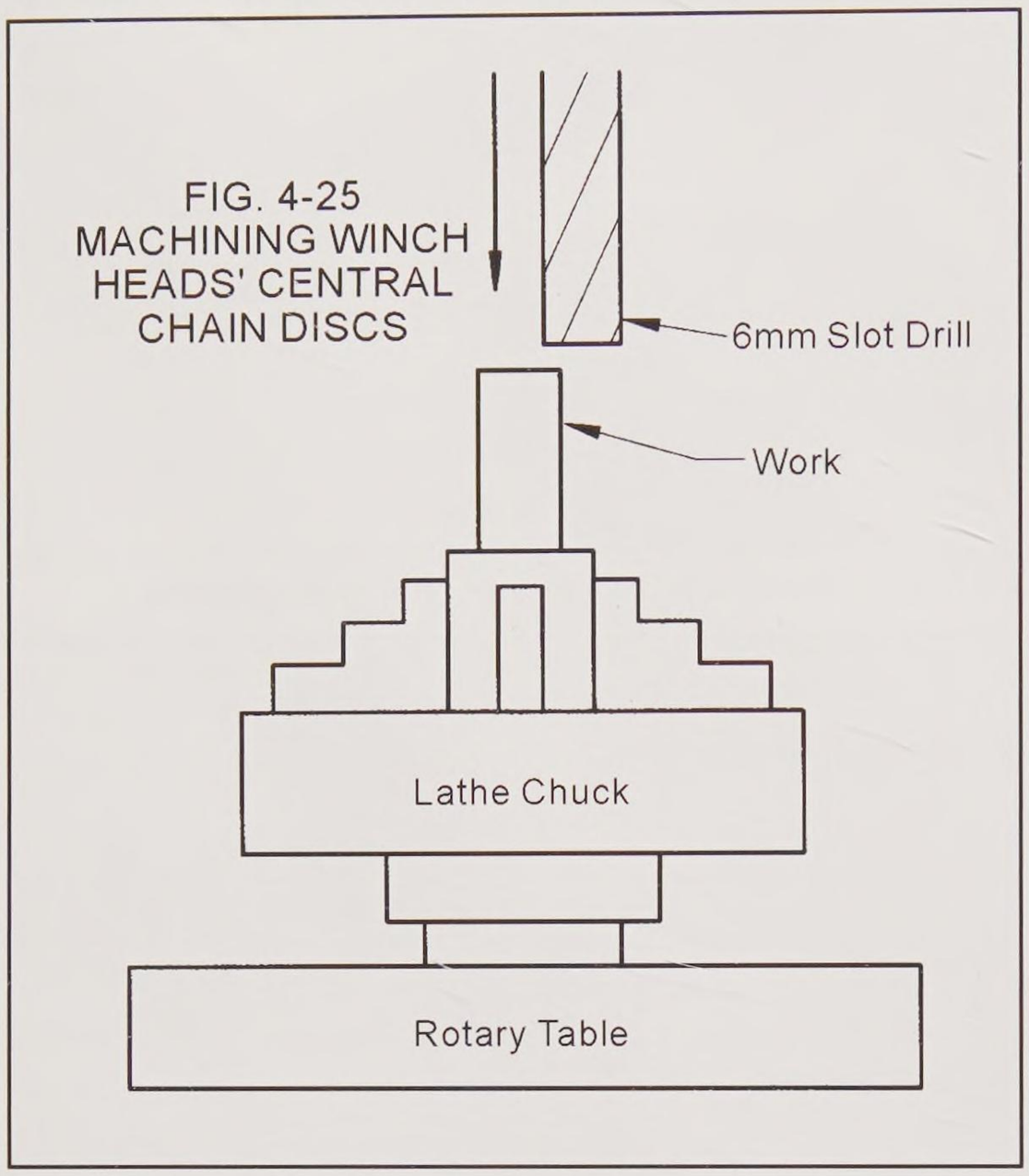


FIG. 4-25
MACHINING WINCH HEADS' CENTRAL CHAIN DISCS

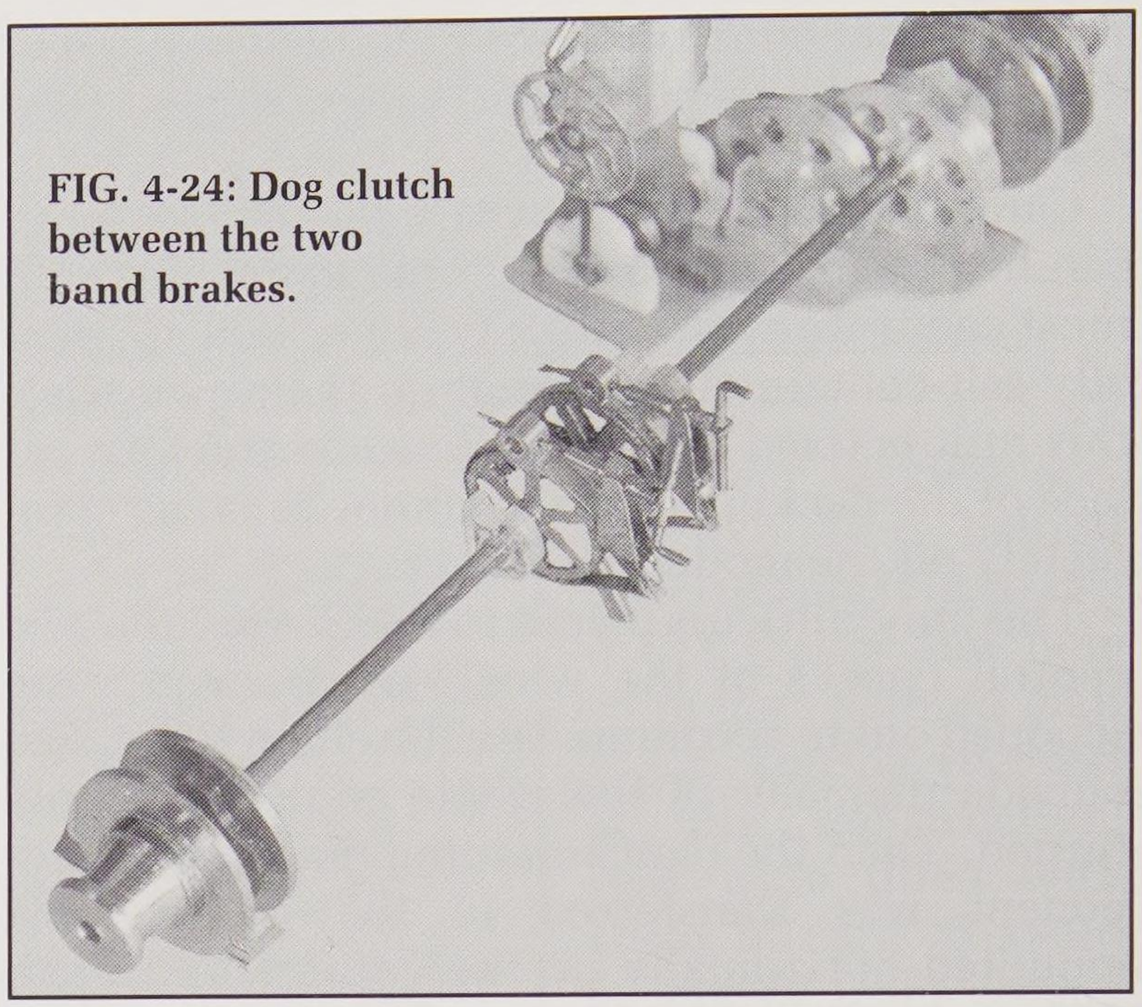


FIG. 4-24: Dog clutch between the two band brakes.

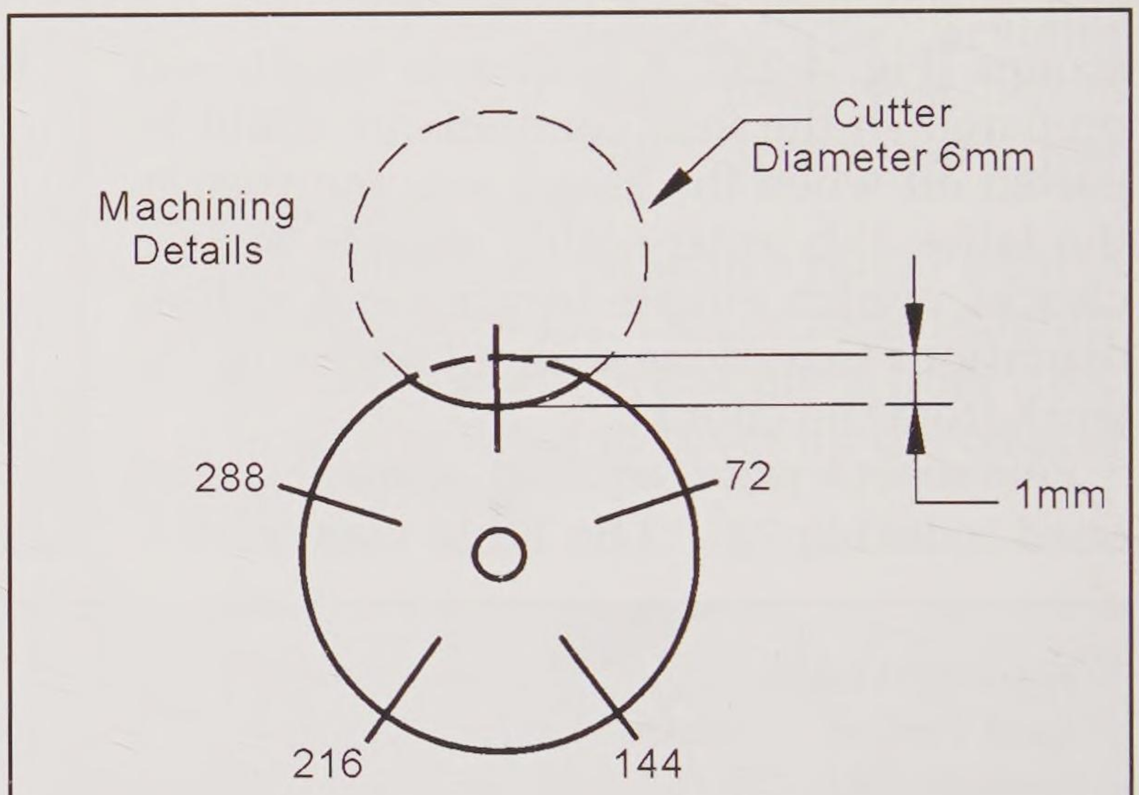
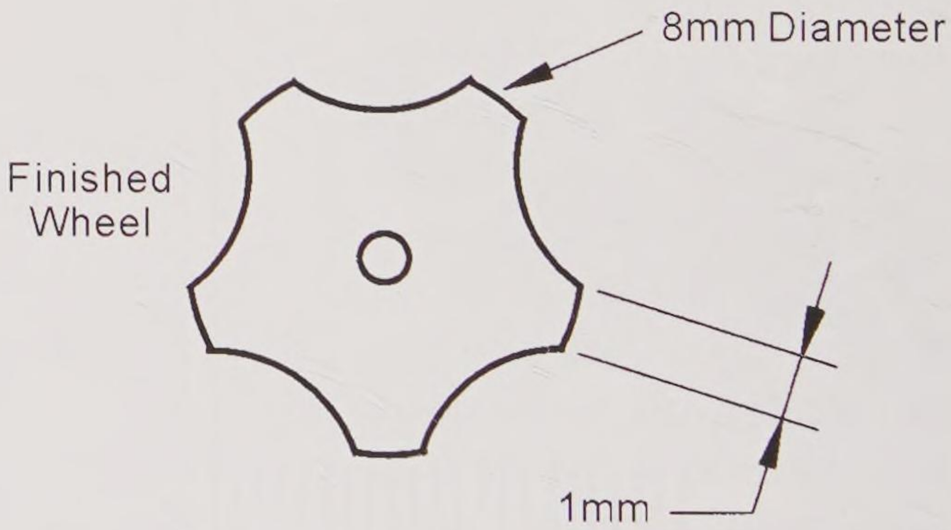
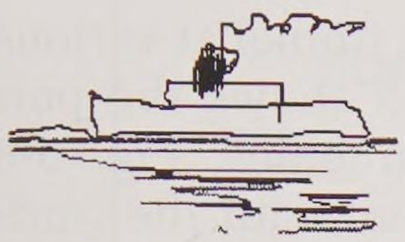


FIG. 4-26
CHAIN WHEEL FOR DECKHOUSE WINCH





Chapter Five

Funnels

Since they were first used, funnels have remained largely – well, funnels. The only unusual thing about the Victorian era was that several classes had their funnels side by side and not in line as is now the usual practice. This was due to the boiler arrangements and had no further significance except probably to increase wind resistance. **Figs. 5-1** to **5-3** show the funnel arrangements on *Devastation, Empress of India* and *Magnificent.*

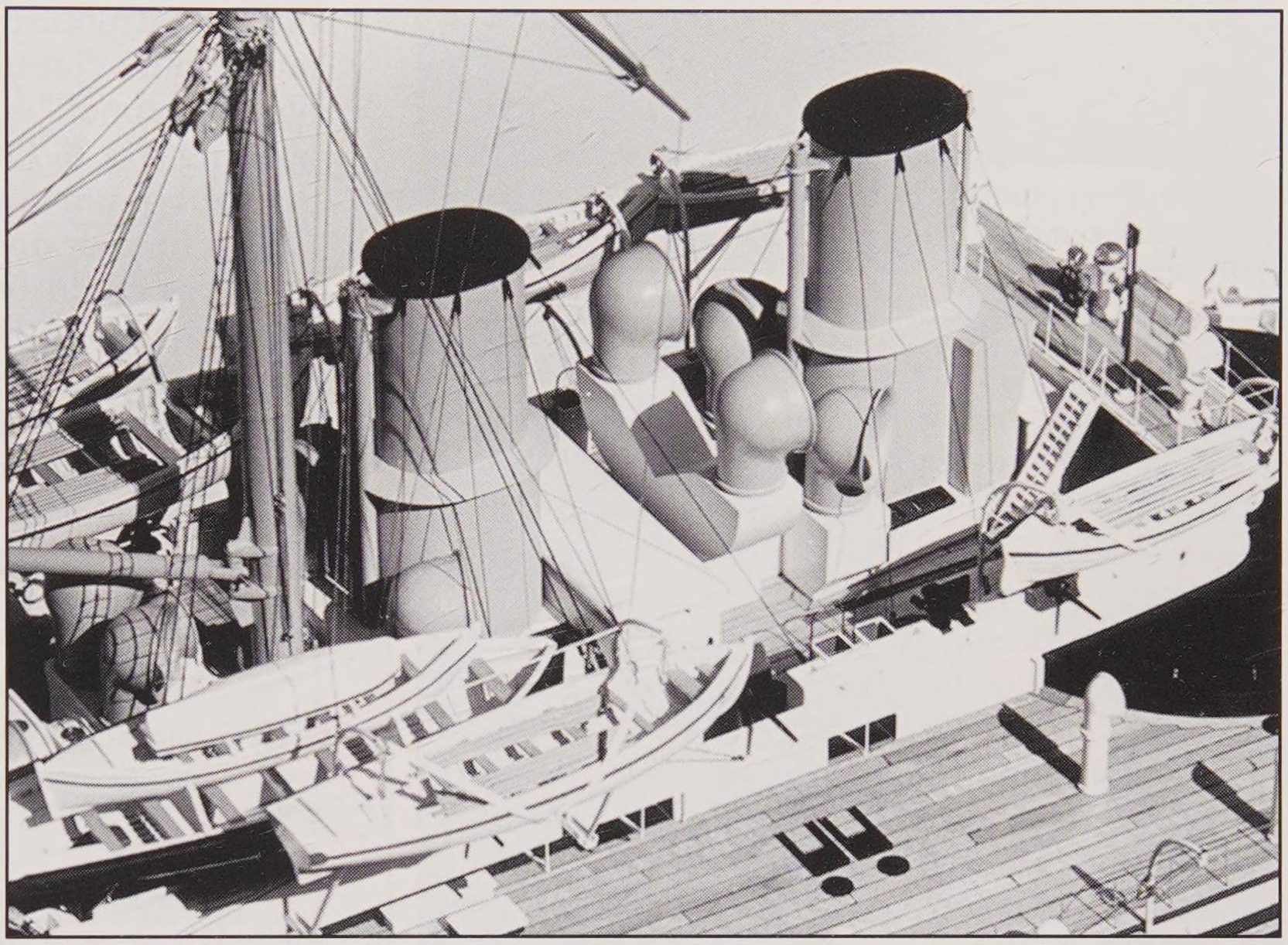


FIG. 5-1: Funnels on *Devastation*.

Owing to *Duilio's* turret arrangements, the aft funnel was circular in cross section, but the fore funnel was slab sided and mounted to the port side of the fore and aft centre line. This allowed the starboard turret to fire ahead. Both funnels had an upper and lower portion, the upper fitting into the lower. The colour above the flying deck was buff and below white (**Fig.5-4**).

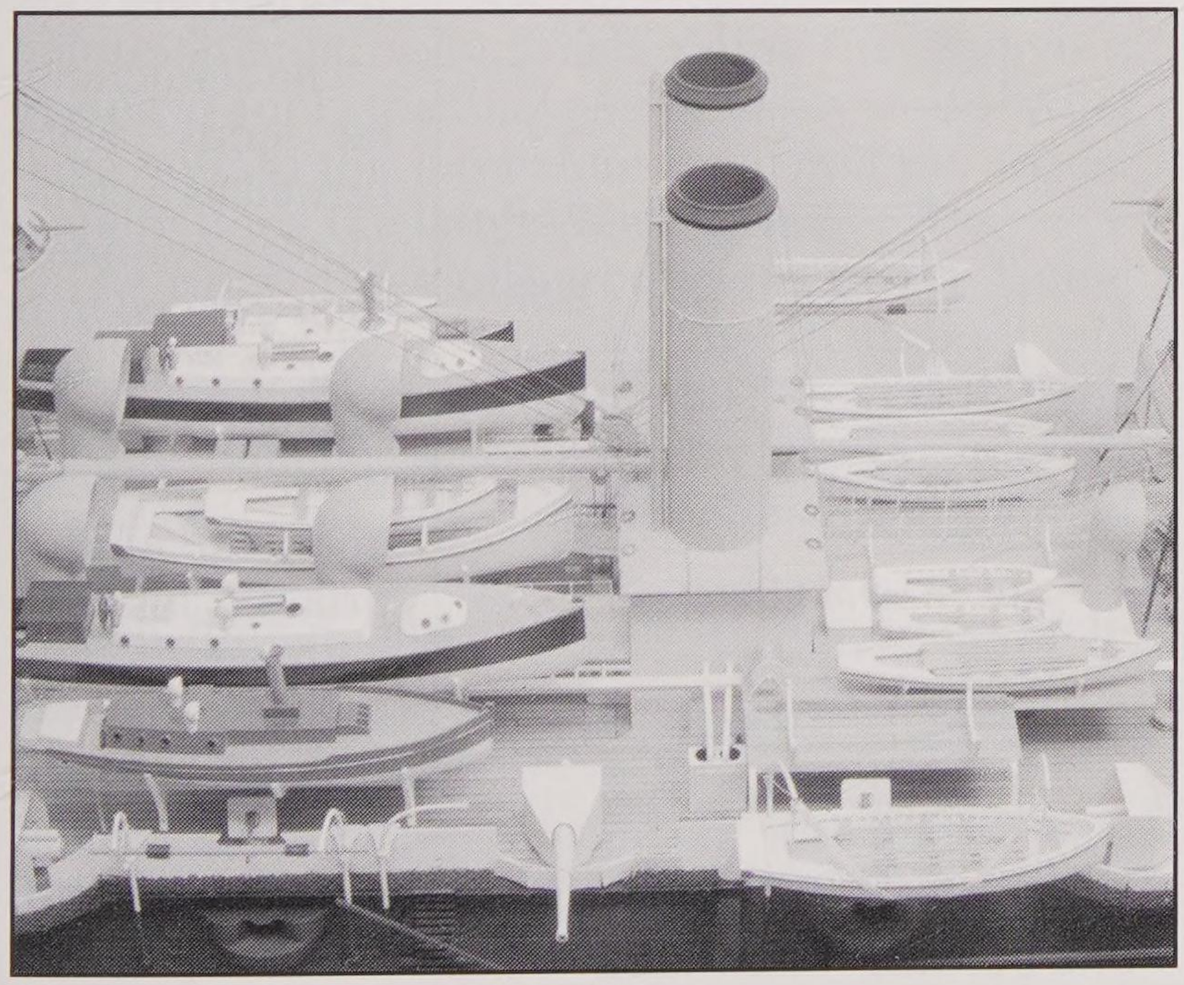


FIG. 5-2: *HMS Empress of India*.

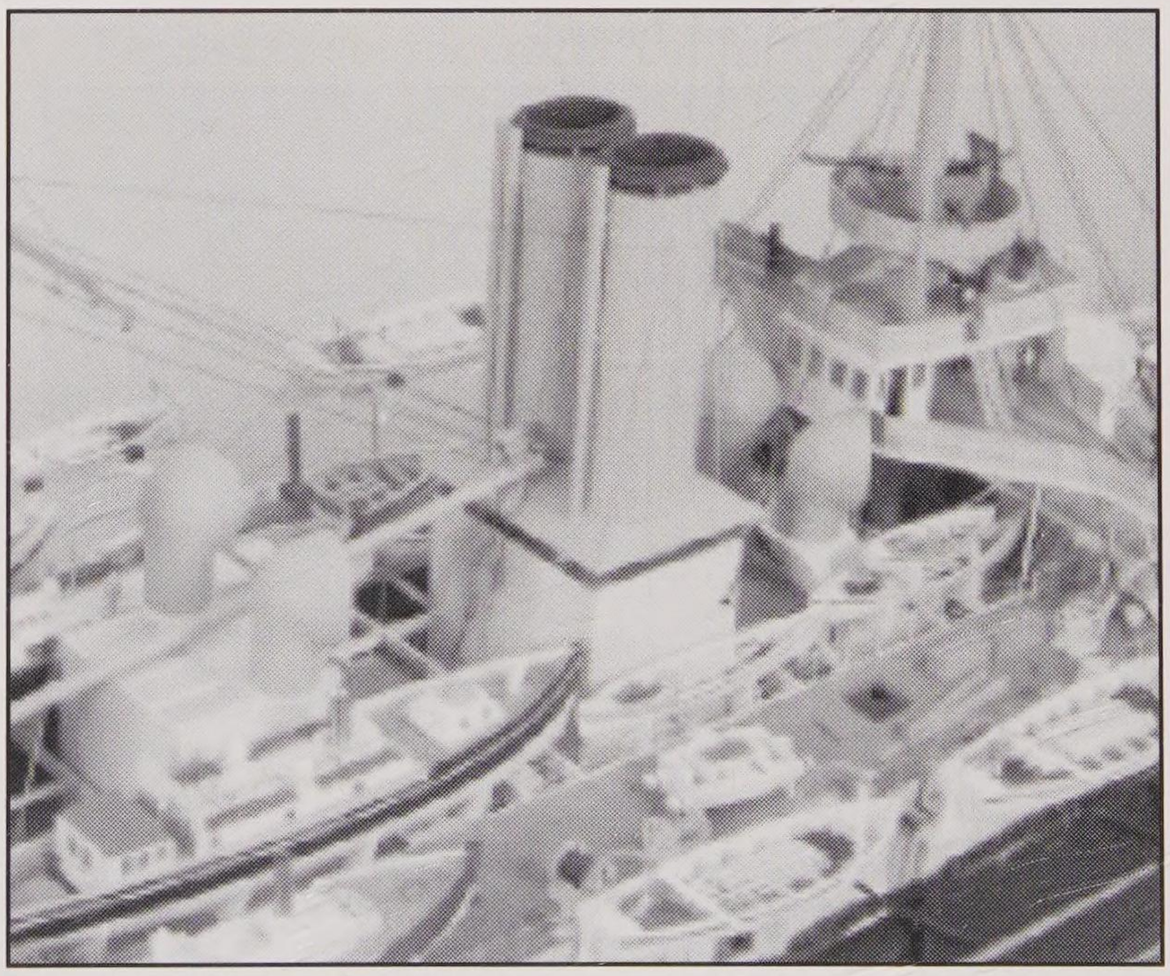


FIG. 5-3: *HMS Magnificent*.

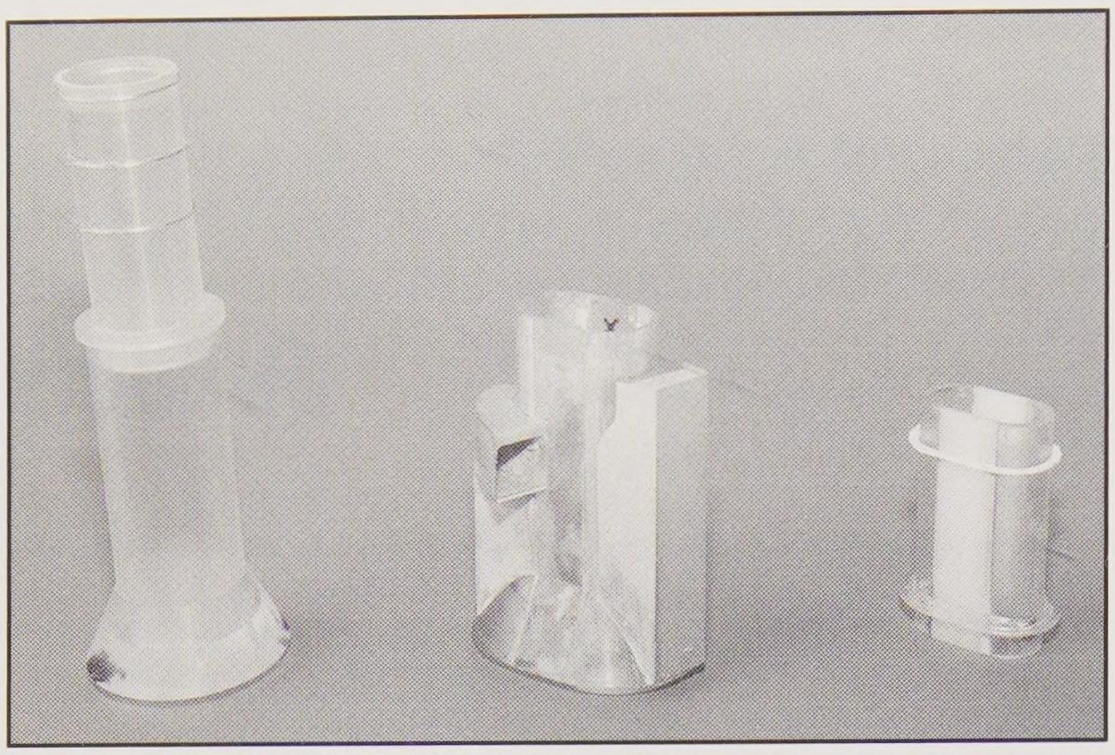


FIG. 5-4: *Duilio* funnels before painting. The fore funnel is shown unassembled at the centre and right. The aft funnel (left) is assembled.

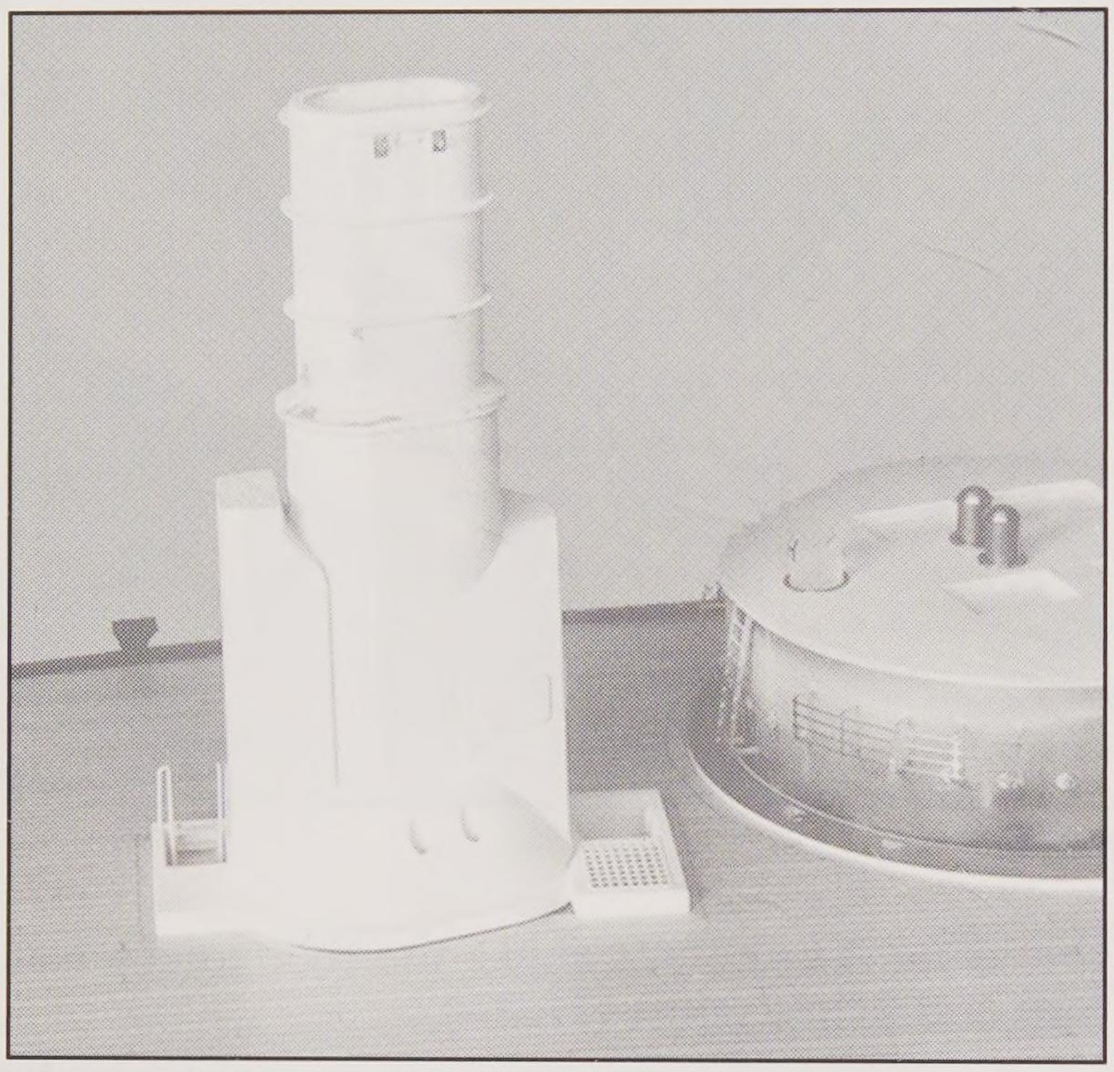


FIG. 5-5: Port side of fore funnel.

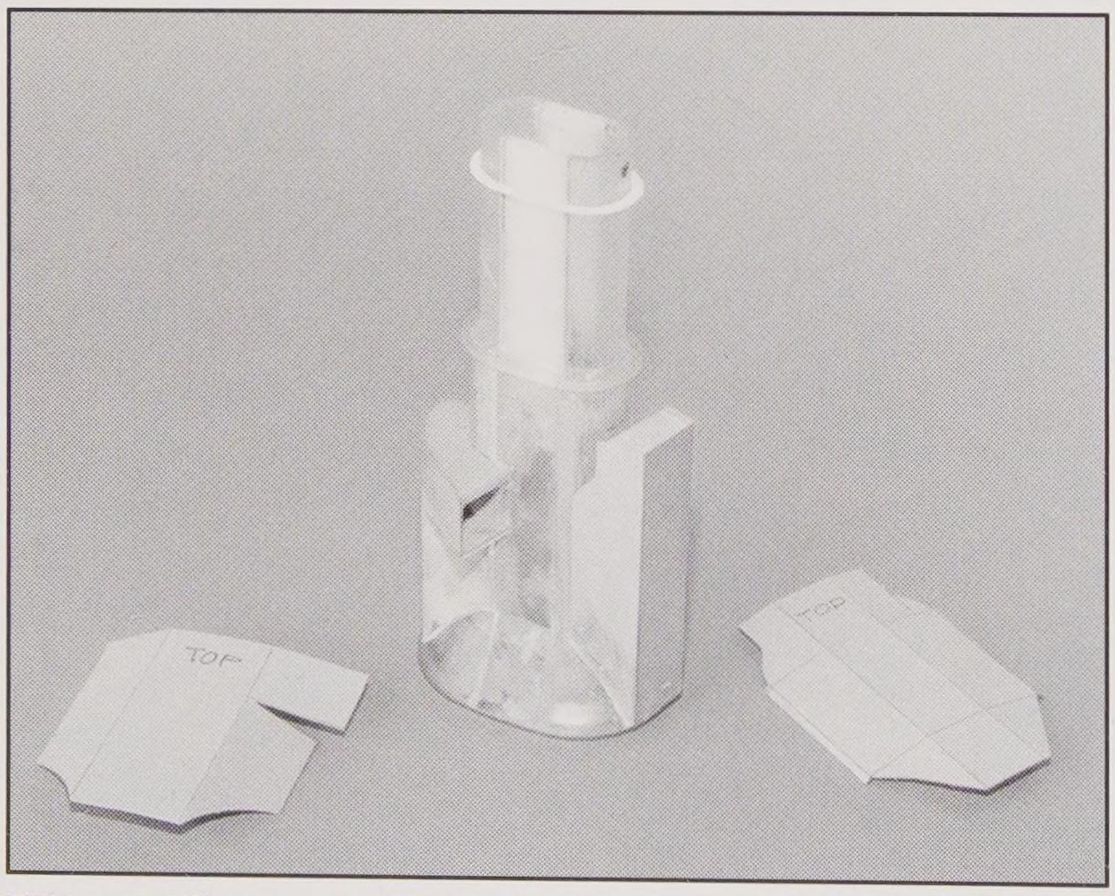


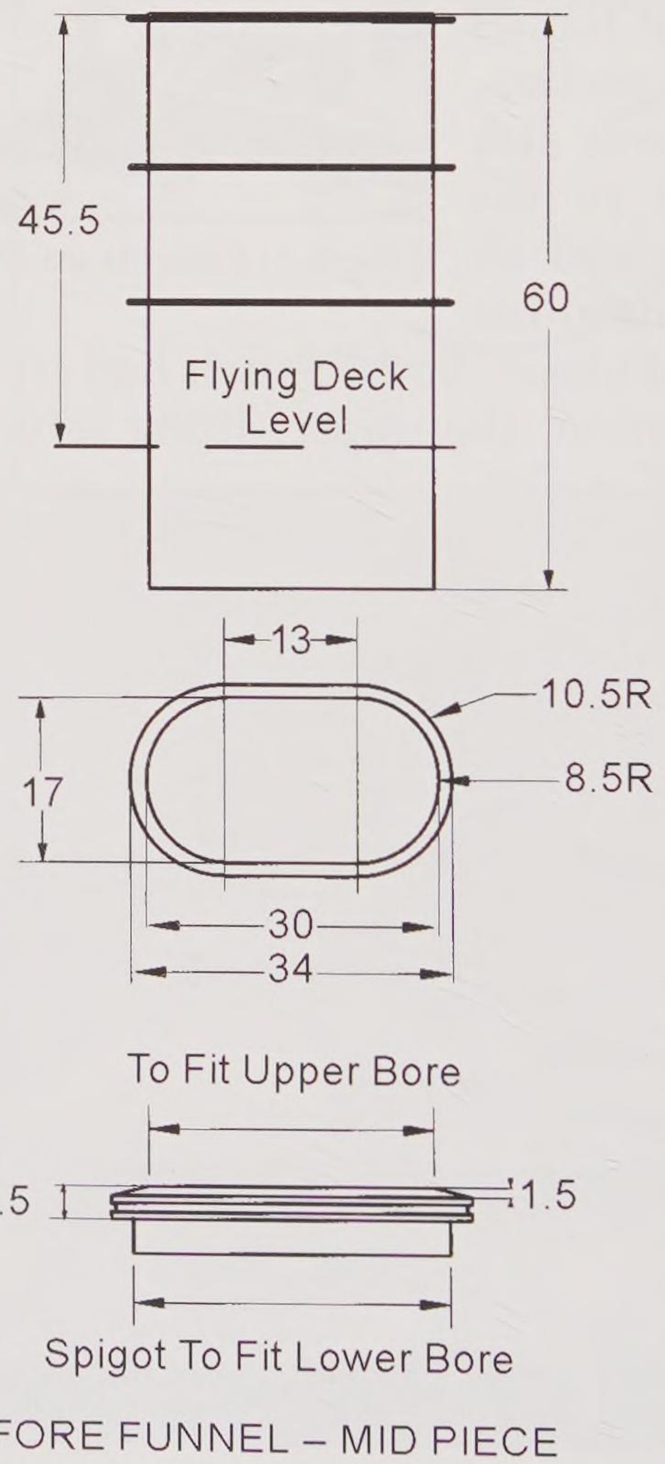
FIG. 5-6: The erected but unpainted assembled fore funnel.

Fore funnel

Figs. 5-5 to **5-7** show the fore funnel at various stages of construction. **Fig. 5-5** shows the port side with ventilator's location holes. **Fig. 5-6** shows the unpainted fore funnel with the cardboard pattern for the "euphonium's" litho plate wrapping to the left. To the right is the pattern for the fore structure. Altogether the fore funnel is much more complicated than the relatively simple aft funnel. A grill closed the euphonium's opening. **Fig. 5-7** (c/s) shows the fore funnel with the euphonium air intake.

This funnel, unlike the aft, was slab sided and therefore could be turned only partially on the lathe. Several methods of manufacture are possible with such a shape. Cold moulded veneer – aluminium (litho plate or beer can) rolled around an internal former – is one way. However, using the same material for both funnels is attractive, as it should respond to paint in the same way. As the aft funnel was made of Perspex, so the fore funnel was of Perspex. **Figs. 5-8** and **5-9** show the manufacturing drawings for the fore funnel.

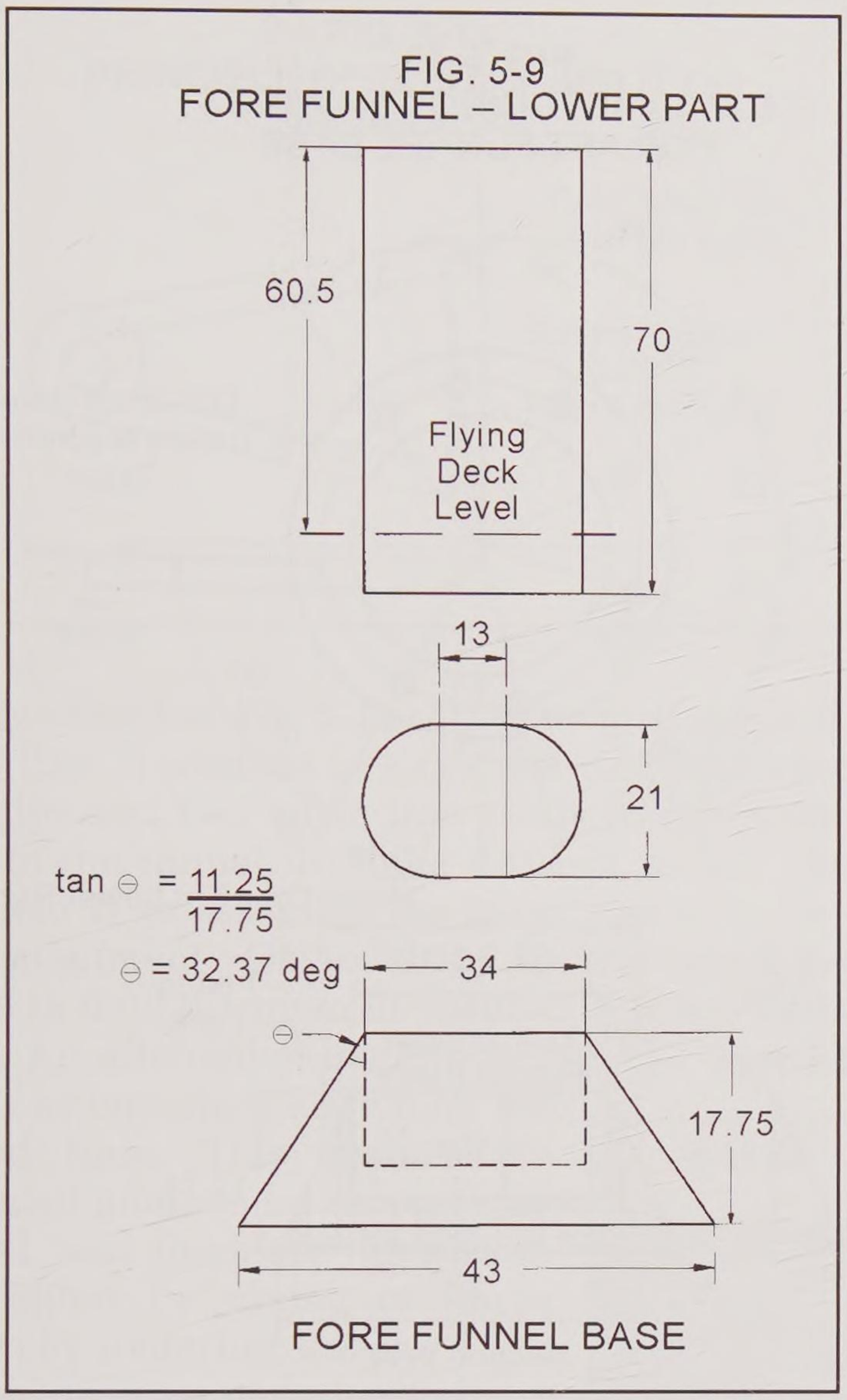
FIG. 5-8
FORE FUNNEL – UPPER PART



FORE FUNNEL – MID PIECE

Slab-sided funnel technique

The semicircular ends were turned as a complete cylinder, then divided into two similar halves. These were spaced apart the appropriate amount with parallel side sections of Perspex. The whole lot was glued with cyano. Some kind of internal spacer



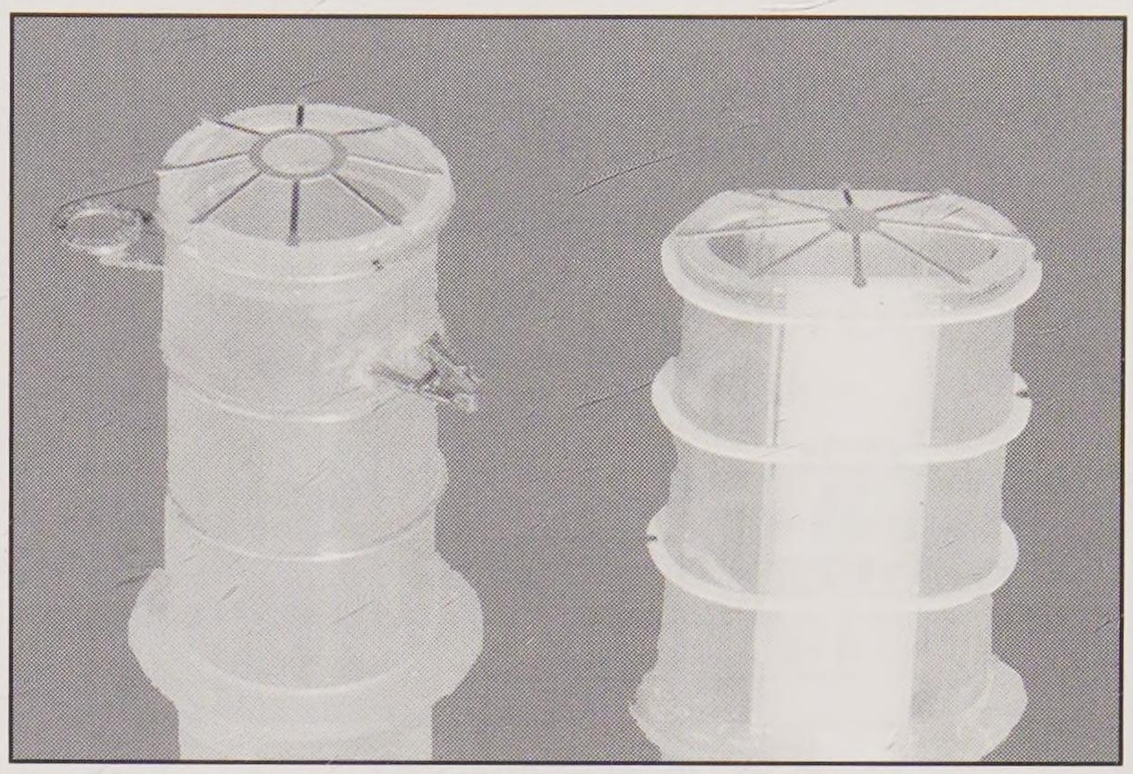


FIG. 5-10: Brass etched funnel caps. Note the rings.

is usually required to hold the four parts in their correct relative positions. The technique is to spot glue the parts together, then remove the spacer before attempting to finish gluing the assembly. Trying to apply the final amount of cyano, or what have you, to the job before removing the spacer usually finds the latter glued inside.

The rings (three off) around the upper funnel could not be turned (as for the aft funnel) and were therefore made from 0.02" polycard. The outside diameter was scissor cut after the internal shape was cut out and fitted using a pointed blade.

Both funnel caps were made from brass etchings (**Fig. 5-10**).

Funnel furniture

A large euphonium-shaped air intake was draped around the fore funnel's aft, starboard side. It presented difficulties. The plan shape of the top was cut out in 3mm Perspex and cyanoed into position. This provided a datum. It was decided to clad the structure with aluminium litho plate rather than use brass shim. This decision was taken as the shape was complex and litho plate is easier to cut and has less spring back than brass. Annealing will take the spring back out of brass shim, but that gives rise to other problems such as making it very soft and easily distorted.

With the datum established, the interior was filled with balsa to provide a foundation for the cladding. This is one time when using balsa is a good idea, as it can be shaped easily and will not become a finished surface. Any odd holes were filled with Isopon and the whole lot cleaned up to form a proper base on which the aluminium cladding could be glued.

Aft funnel

Fig. 5-11 (c/s) shows the completed aft funnel in situ. **Fig. 5-12** is a manufacturing drawing for it.

The upper part was machined from suitable Perspex tube with the top 25 diam. flange machined in. The three thinner rings were machined from aluminium tube and parted off. (They could not be machined in situ on the main tube, as its diameter was too small.) These were forced on using the lathe and a suitable supporting tube. The lower part was machined to size from suitable Perspex tube.

When making the base, it was decided to drill the seven 3mm diam holes for the seven cowl ventilators, as this would give positive and correct location. It was essential to do this before machining the 25.6° tapered sloping sides. **Fig. 5-13** shows the calculations for placing these holes.

FIG. 5-12
MANUFACTURING DRAWINGS
FOR AFT FUNNEL

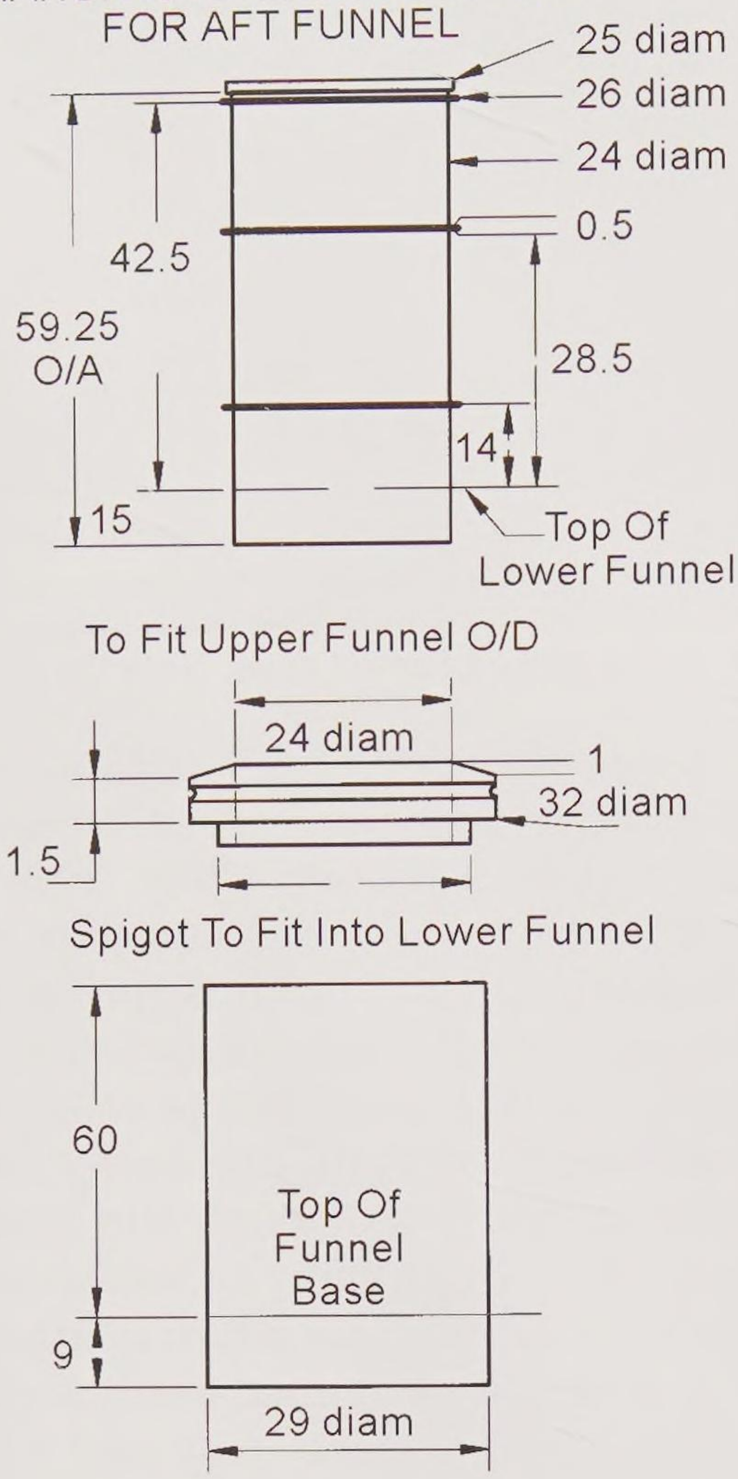
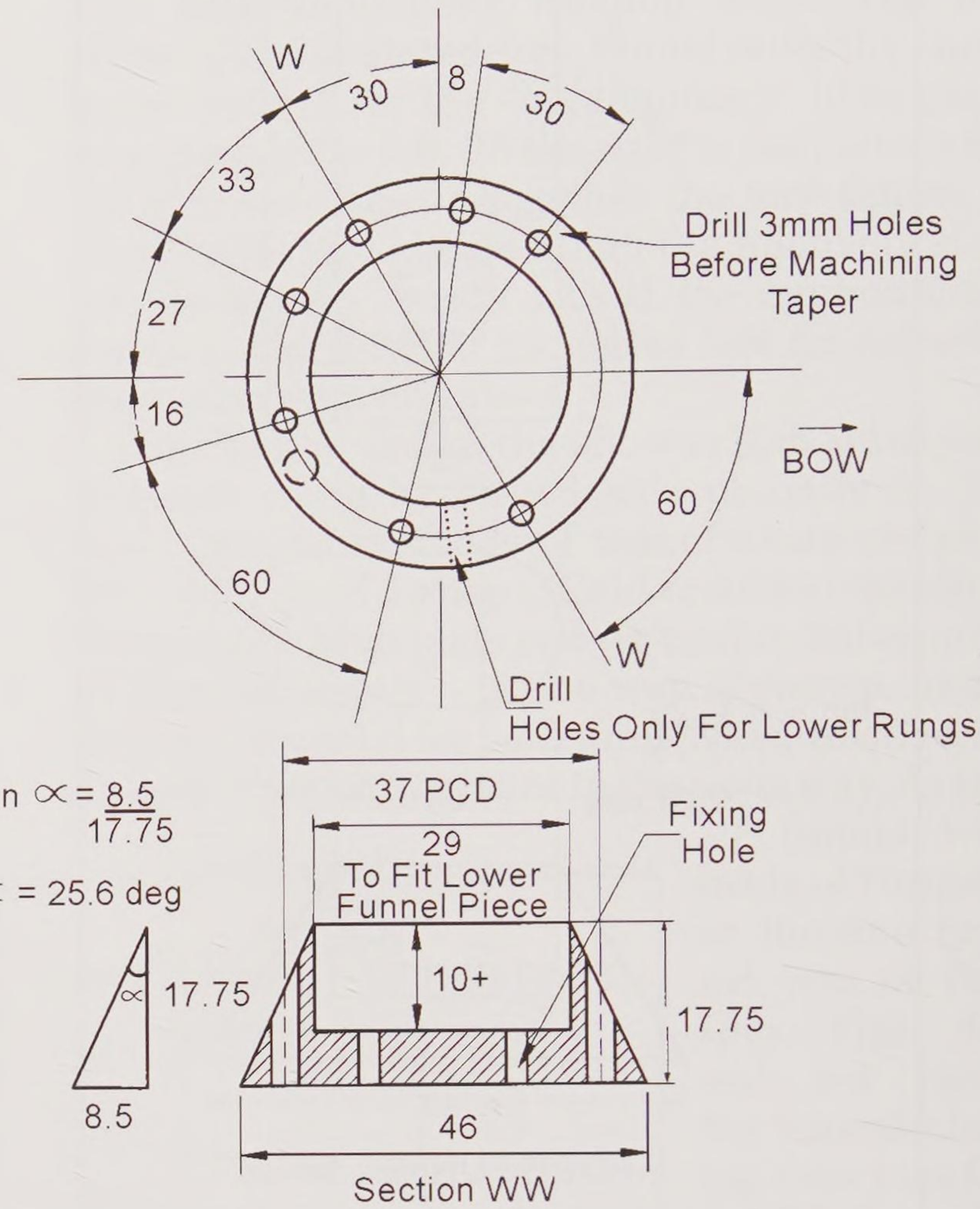


FIG. 5-13
MANUFACTURING DRAWINGS
FOR AFT FUNNEL BASE



Steps for machining aft funnel base

1) Saw off a suitable piece of Perspex and face.
2) Reverse and turn spigot to fit rotary table centre; i.e., 1" diam leaving 17.75 thickness of base.
3) Hold on 1" diam spigot and machine in recess approx 10 deep x 29 diam to house lower part of funnel. Mark 37 diam on face for 3 diam holes for cowl ventilators.
4) Set up rotary table on mill and centre with setting piece.
5) Offset table 18.5 (37/2) to pick up marked circle (Op. 4).
6) Calculate all 3 diam hole angles from zero position and centre drill. Two small holes were drilled on the datum centre line for reference later.
7) Centre drill all 3 diam holes using rotary table settings.
8) Repeat with 3 diam drill.
9) Re-chuck on lathe and complete machining 25.6° taper.

Central adaptor

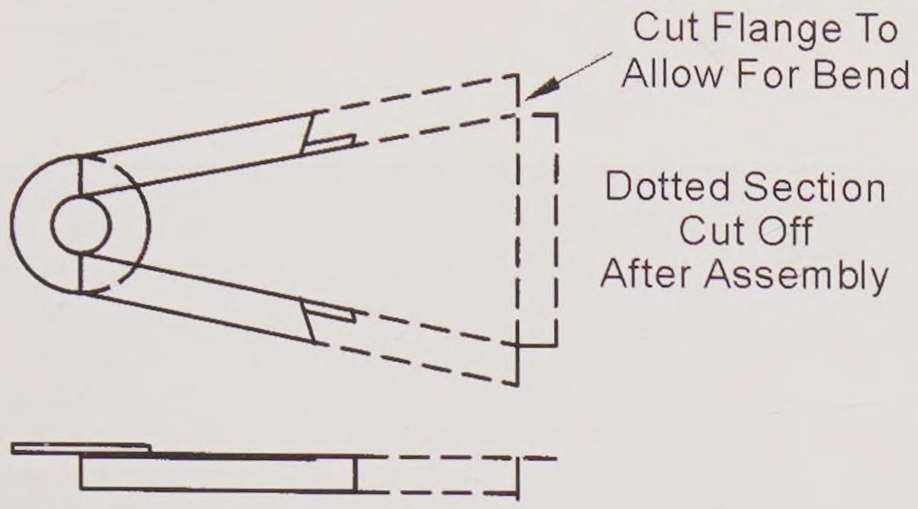
1) Using a suitable Perspex disc, hold on outside diameter and bore 24 diam through to take upper funnel.
2) At same setting, turn spigot to fit into top of lower funnel.
3) Turn plug to fit into 24 diam bore to support spigot when chucking on same.
4) Turn outside diam to 32.5 diam.
5) Turn tapered top face.
6) Put in recess on outside diam.
7) Remove plug.

Principle of sustainability

Now is a good time to expound a design theory that aids assembly using the following examples:

A steam – at least I think it is – pipe runs up the aft side of *Duilio's* aft funnel and is secured at its

FIG. 5-14
PRINCIPLE OF SUSTAINABILITY –
PIPE BRACKET



top by a bracket. **Fig. 5-14** shows its final shape in solid line. It consists of a circular ring enclosing the pipe and two angle iron struts to attach the ring to the funnel. Nothing difficult so far. The problem is to assemble the three pieces in correct alignment. Obviously a fixture could be made to hold the them in position, but this takes time. An alternative method is to make the two struts as one piece shown by the dotted lines. This enables the included angle to be set and sustained, and therefore the assembly, either by gluing or, more likely, by soldering, easy.

The other example is the bracket fitted to a strut supporting the wing of *Duilio's* flying deck. It holds the mooring boom's topping lift. On first thought the component obviously consists of three pieces, two turned cylindrical tubes and a flat joining plate (**Fig. 5-15**). That's how I first saw it. The problem is joining the three pieces. Certainly an elaborate fixture could be made, but its construction is complicated by the two tubes' different diameters. As only two brackets are required, such a fixture is unattractive idea.

A different construction method was sought to make assembly easier. One principle is to reduce the number of parts to a mini-

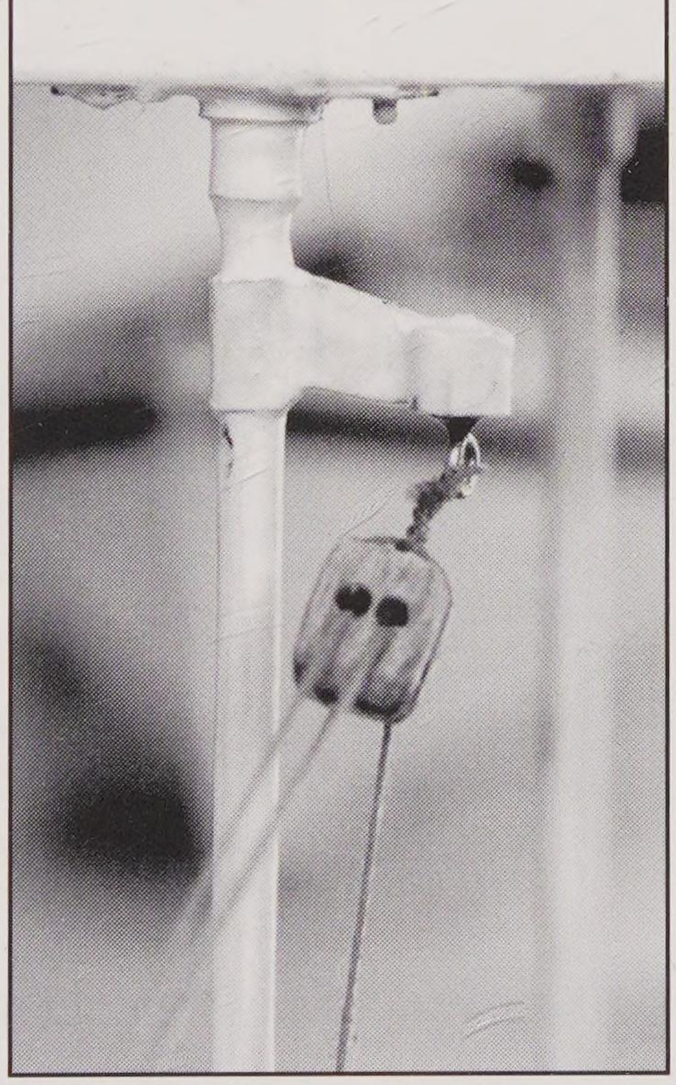
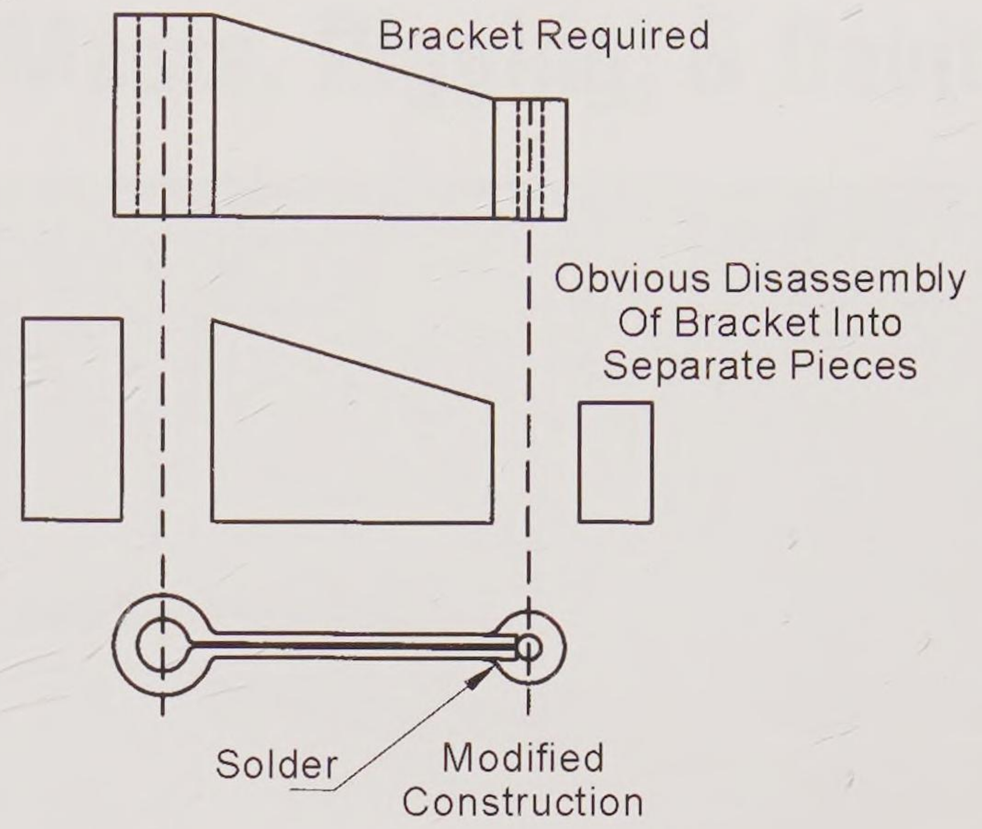


FIG. 5-16: Topping lift brace on bridge supports.

FIG. 5-15
PRINCIPLE OF SUSTAINABILITY
TOP LIFTING BRACKET



mum. I decided to replace the main tube with a piece of 0.008" brass strip wrapped around the column and clenched up tight (**Fig. 5-15**). This reduced the main tube and the web between the tubes to one piece. The free ends were inserted into a slit fret sawed into the other tube, thus producing a sustainable assembly that merely required soldering.

When making the "wrap-round," first use pliers and finally clench up tightly using a smooth jawed vice. **Fig. 5-16** shows the end result.

These two examples are straightforward, but the principle should be applied to all such components. Your first basic ideas – if you like the obvious – may not, and almost certainly will not be the best way to reduce the number of pieces in an assembly. If the parts are to be photo-etched, a bit of cunning may enable several to be connected at the etching stage. If possible, the design should be made self-locating, so parts fit together automatically and do not require elaborate external means of support to hold them in the right position.

Chapter Six

Masts, Rigging, & Davits

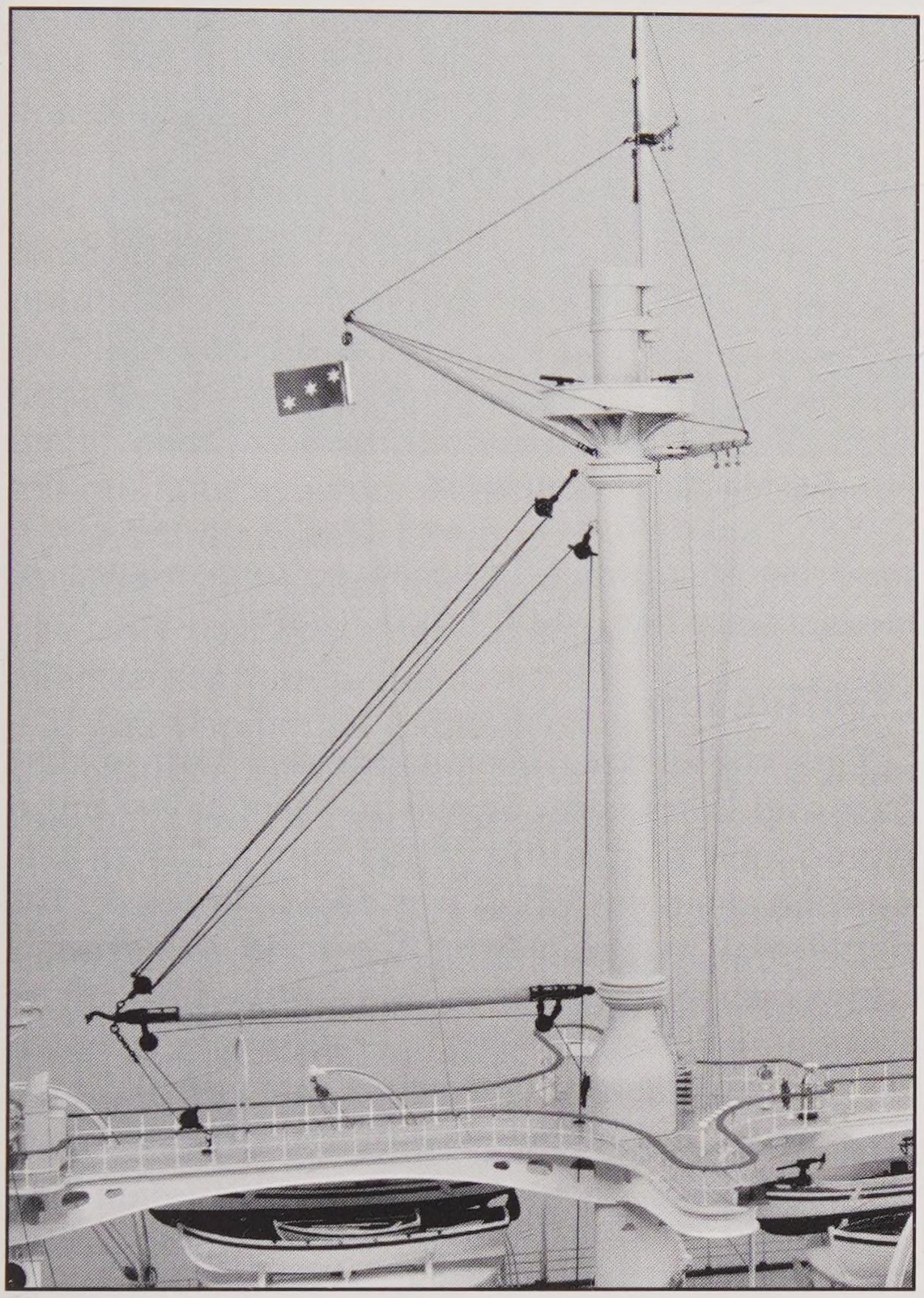


FIG. 6-1: *Duilio's* masts.

HMS Devastation was the first ship to do away with sail-carrying masts. Unfortunately, they came back again later for some reason unknown to the author. It should be explained, to avoid confusion, that the RN calls the aft mast the mainmast; although, on many warships it is of lighter construction than the massive foremast. The writer thinks this seemingly contradictory arrangement comes from the time when sailing warships had three masts, the centre one being the mainmast. We have now lost the aft, or mizzenmast, of course.

RN Duilio also had only a simple, largely unstayed mast with one fighting top (**Fig. 6-1**). The lower end of the mast fitted into the conning tower.

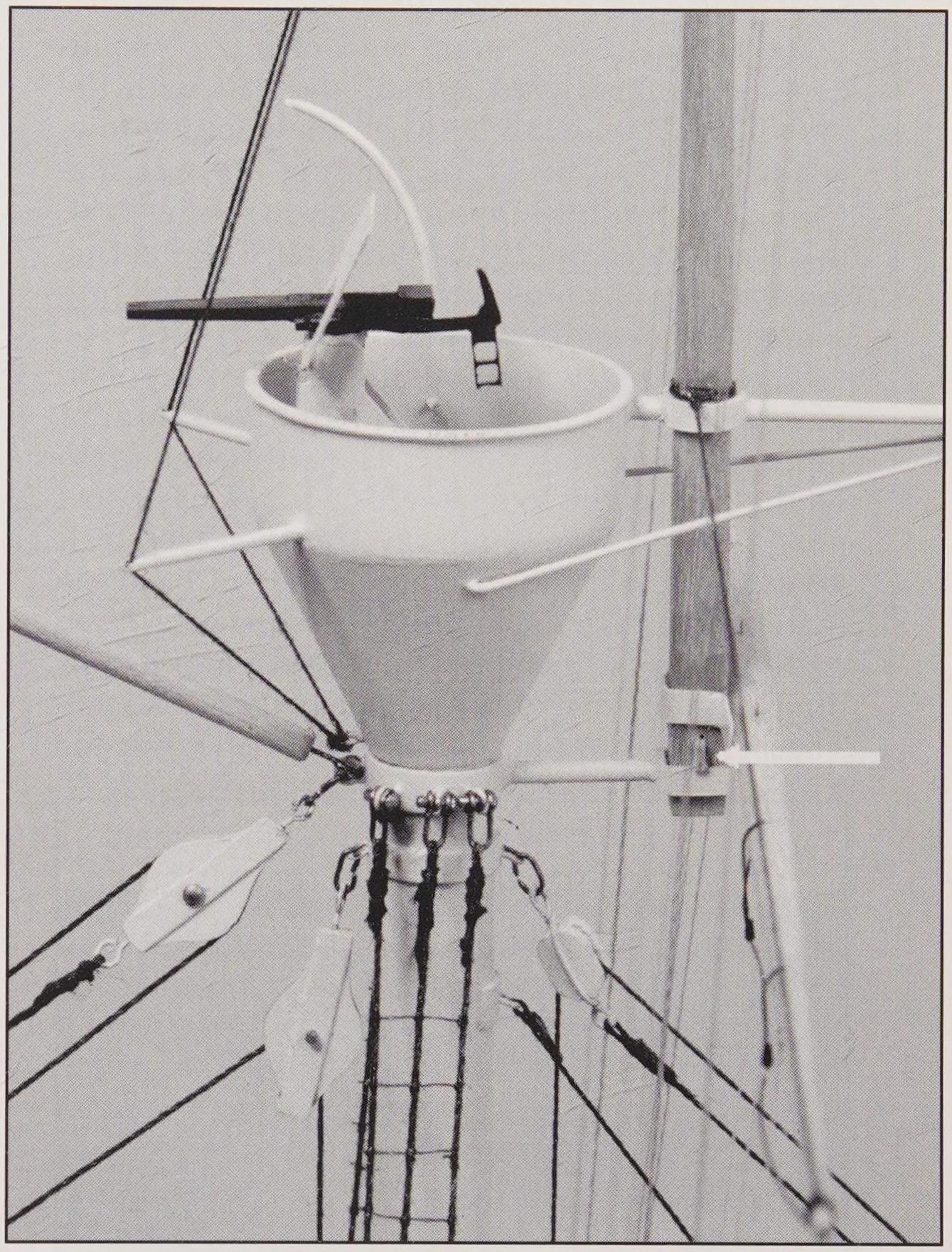


FIG. 6-3: *Victoria's* mast with fighting tops and davit. White arrow points to fid.

Some ships of the period had two fighting tops per mast. *Magnificent* had four all equipped with quick firers (**Fig. 6-2** c/s). Access to these tops was usually by a ladder consisting of rungs fixed to the mast. To get into the top, a "lubber" hole existed in the underside cone with trap doors in the deck. (Sailing ships had lubber holes to avoid climbing around the outside of the futtock shrouds).

Often a pivoted davit was fixed to the bulwark of the top for lifting ammunition or whatever (**Fig.**

6-3). The davit's lower end was weighted so it could be stowed horizontally when in action to avoid impeding the guns. Also note the fid through the lower end of the topmast to prevent it from sliding through its holding brackets.

Constructing *Duilio's* mast

Fig. 6-4 (c/s) is a general view of *Duilio's* semi-completed mast, yard, boom, and gaff with the drawings. The length between the conning tower's cap to just above the fighting top was machined from solid aluminium rod. To save weight, this was drilled out from both ends. The fighting top was also machined from the solid, which presented an interesting exercise (**Fig. 6-5**).

Incidentally, when buying nonferrous bar, make sure it is of machining quality. Pure aluminium machines very poorly. The swarf builds up on the face of the tool, resulting in a mess. Most pure metals act the same way; they need some alloying ingredient to produce planes of cleavage that enables clean machining. For instance, "free cutting" (easy to machine) mild steel contains sulphur combined with either manganese or lead. These steels are never used where shock loads may be encountered, because their planes of cleavage are likely to fracture easily.

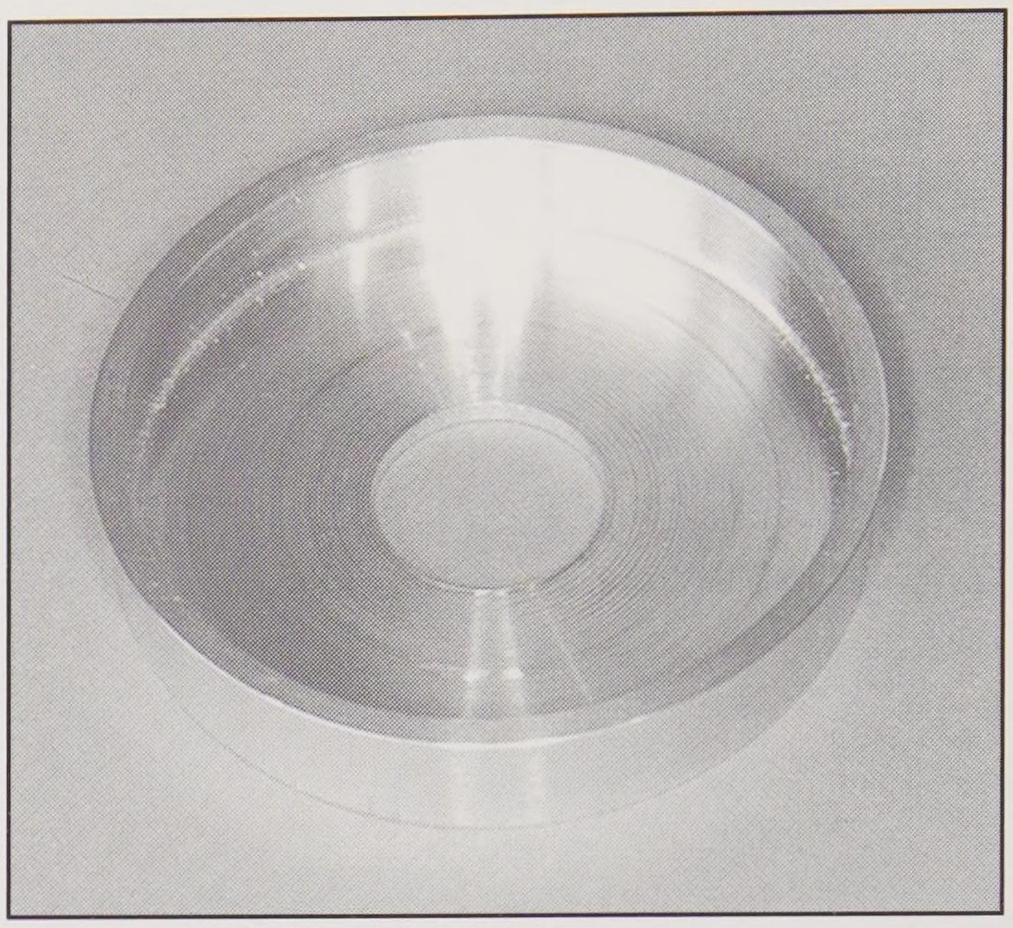


FIG. 6-5: Machined fighting top.

Fighting top

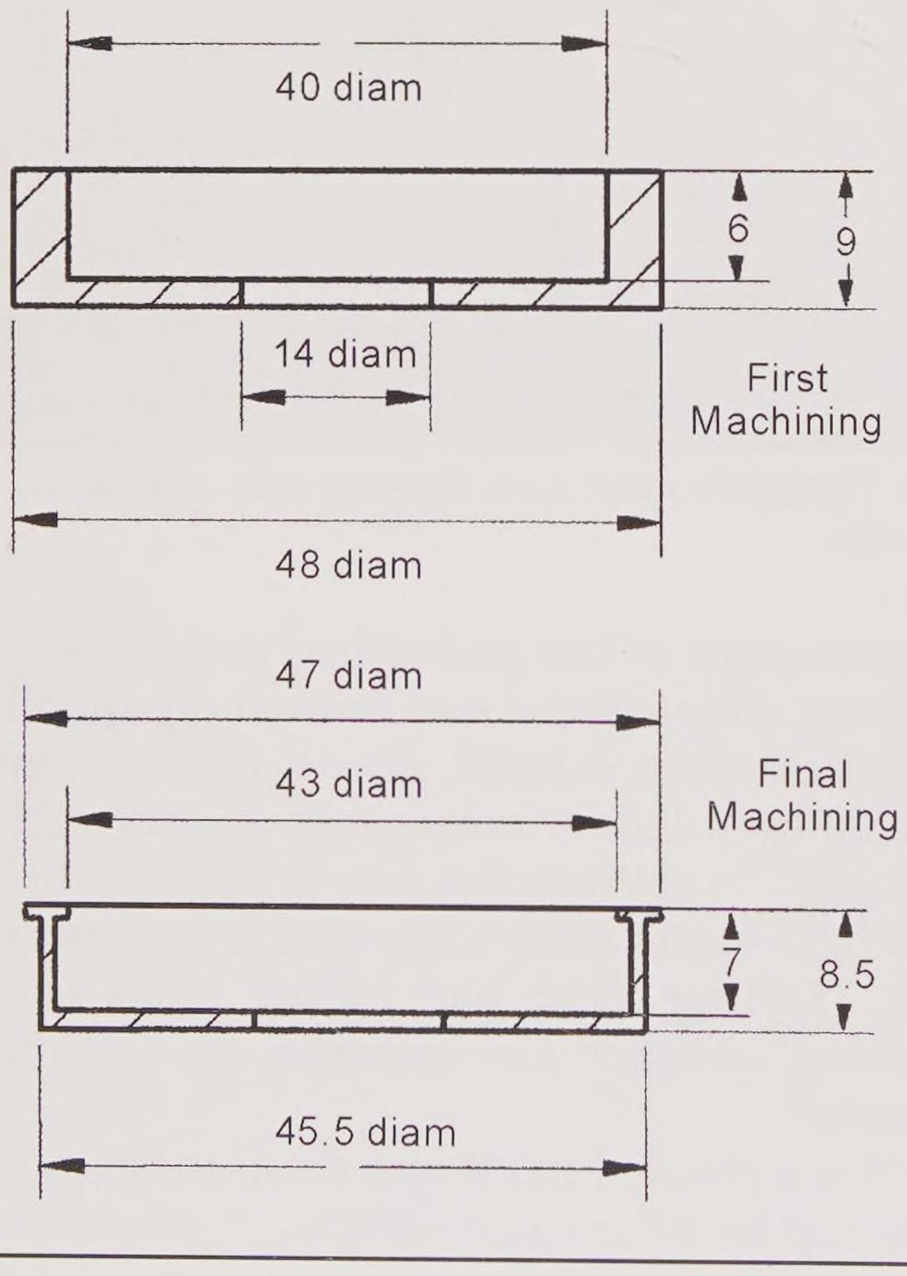
This could have been fabricated with a disc base and brass shim or plastic sheet sides, but it would have been difficult and may not have produced a clean cut job. It was decided to grasp the nettle and machine from the solid to assure a truly clean job. A suitable aluminium/dural blank was found. The following operations are given, as this type of machining requires care and planning (**Fig. 6-6**). All dimensions are in millimeters.

A) Rough turn
   1) Hold on outside diameter (O/D) face, drill and bore 14 diam hole
   2) Turn recess 40 diam by 6 deep

B) Finish turn
   1) Hold on O/D and finish turn recess 43 diam by 7 deep
   2) Hold on recess (I/D) and finish turn 47 diam and thickness 8.5
   3) Finish turn 45.5 diam to produce lip
   4) Hold on 45.5 diam and with undercutting tool put in internal lip

This last operation may be difficult due to tool chatter. Tighten up all screws and reduce tool overhang to an absolute minimum.

FIG. 6-6
FIGHTING TOP MACHINING DRAWINGS



Upper mast and yards

The rest of the mast's upper structure and yards were made from dégamé – an ideal wood for spars. The usual technique was adopted. Firstly,

cut a square sectioned blank. Mark both ends with the reduced circle and taper. Then proceed to make the square, eight sided, then sixteen sided, and finally completely round. Note that some spars are left eight or sixteen sided in the centre and not made completely circular in section.

Narrow black iron or steel bands are fitted at various points. These can be simulated by black paint bands or the job done properly by fitting turned metal ones. The latter can be a tedious job, as every band is a different diameter. Nothing is easy in life! Metal bands are probably best chemically blackened rather than painted.

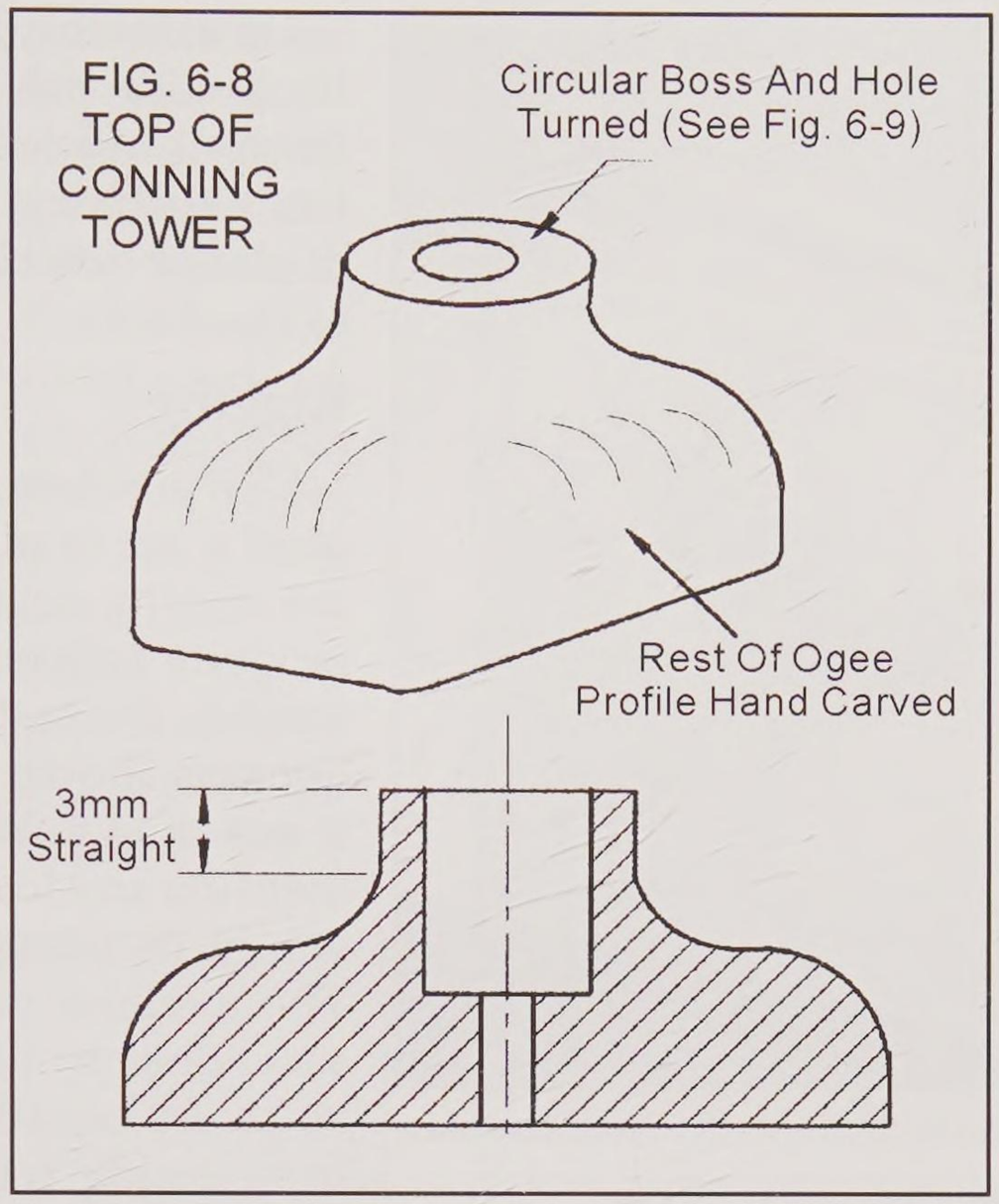
If the bands are painted on, the best way is to use the lathe. If the lathe is put into back gear, it can be run very slowly. Fitting a simple rest to the tool post to support the hand produces geometrically accurate bands easily and quickly. One advantage of using paint is that these bands are usually the home of eyebolts, so drilling holes for them is easier than boring through metal.

Fig. 6-7 shows *Duilio's* unpainted mainmast and metal fittings painted on the finished yard, boom, and gaff.

Conning tower

Since the conning tower is part of *Duilio's* mast, it is included here. A cross section of the conning tower was a parallelogram with rounded corners. It was finished off with an ogee cap above the flying deck (**Fig. 6-8**). Both parts were made from jelutong. The cap's operation sheet is:

1) Cut block to size as a rectangular prism.
2) Mark out top and bottom faces from a card template.
3) Mount the block in a four-jaw chuck and drill the dowel hole and mast counter bore.
4) Turn the top circular for 3mm (**Fig. 6-9**).
5) Band saw the shape (shading in **Fig. 6-8**).
6) Remove the rest of the wood using a burr, gouge, and files.
7) Finish the body and cap with two-part epoxy resin coating as used on the hull before painting.



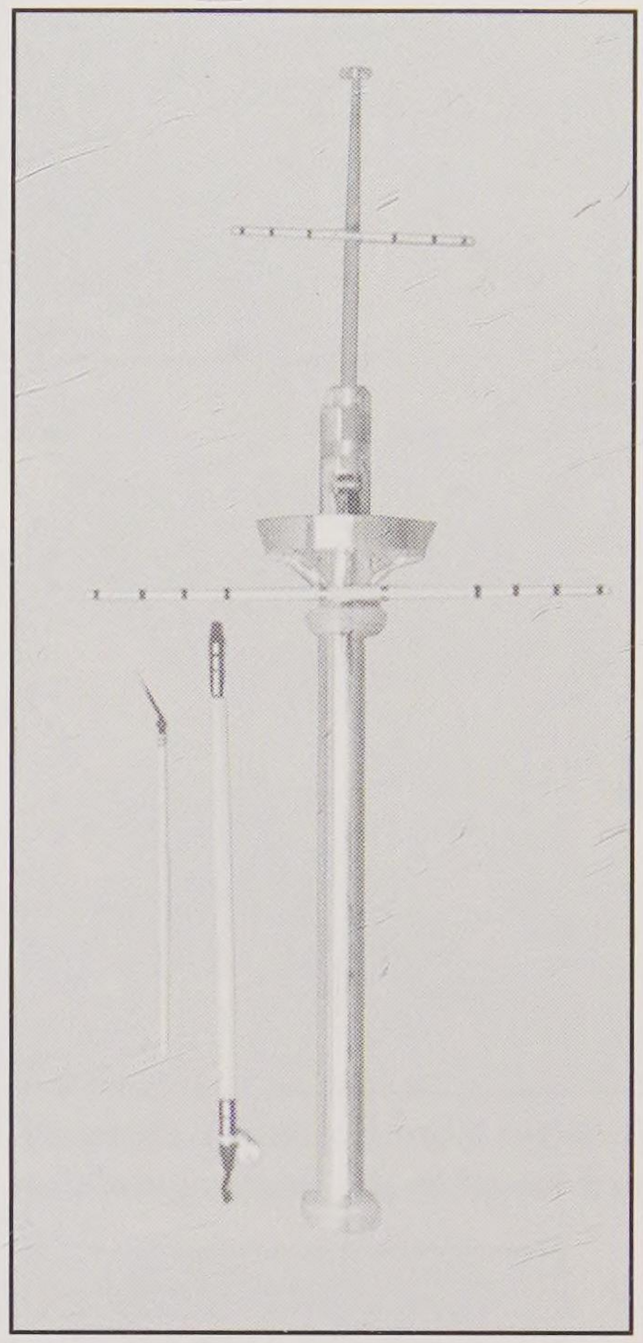
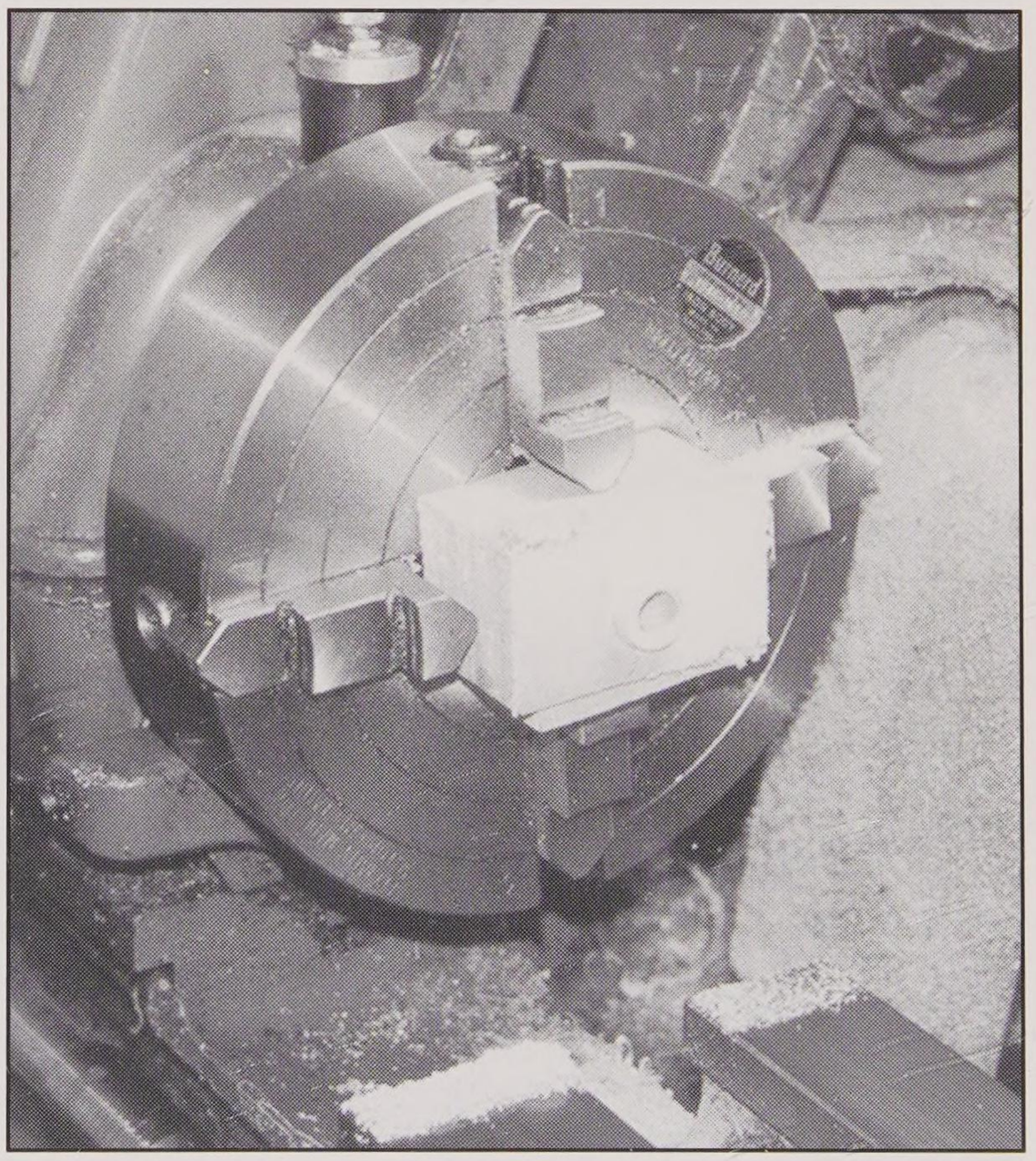


FIG. 6-7 (above): Unpainted mainmast with finished yard, boom, and gaff.

FIG. 6-9 (below).



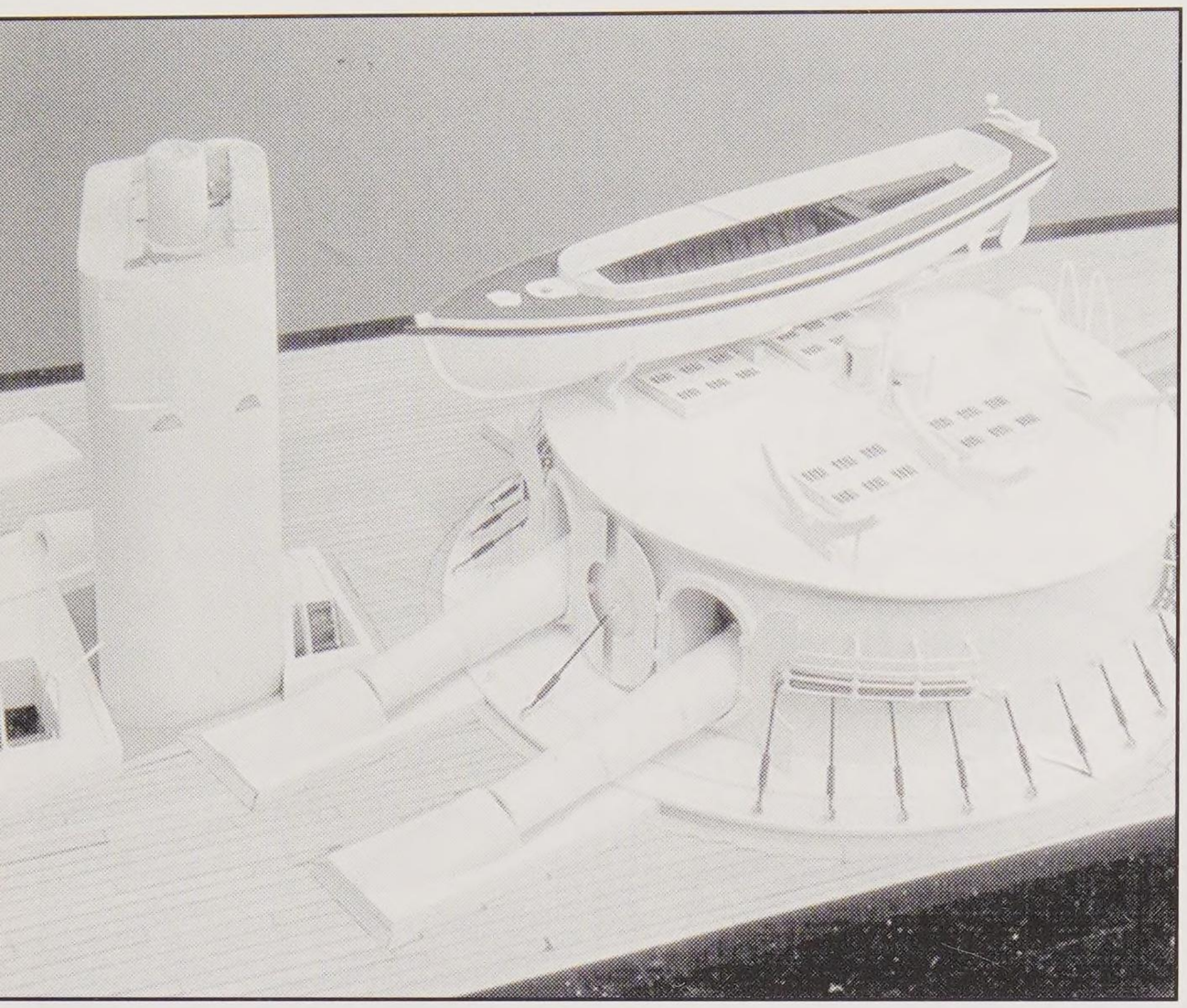


FIG. 6-10: Conning tower screwed to the main deck. Note the starboard turret in the loading position.

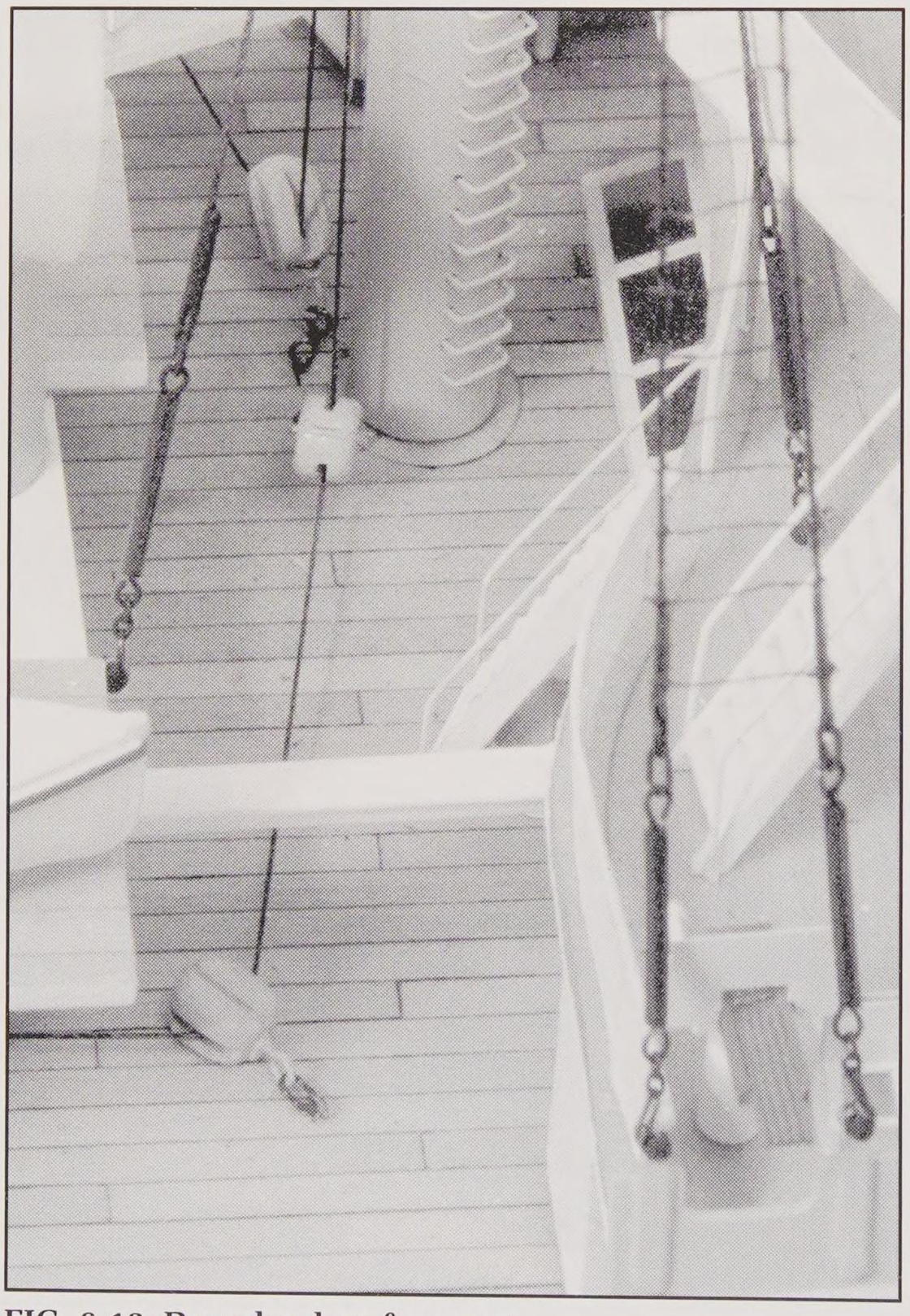


FIG. 6-12: Downhaul on foremast.

On assembly, the body was screwed to the main deck with two long screws (**Fig. 6-10**). Note the 8mm dowel on the top that locates the cap, and the two fixing screws on either side. An 8mm diameter dowel also was used to locate the body to the deck.

Rigging

One problem, and it is a big one, is that however good a set of plans is – and *Duilio's* are superb – the rigging detail is sadly lacking. This seems to be quite universal and can cause a great deal of trouble. For instance, the topping lift for the main boom is shown as a single line. Its belaying point is not shown. With the weight of the boom, not to mention any load (ship's boat), some sort of tackle would be necessary. No winch is shown either. The modeler must rely on observations of what was done on other ships. Unfortunately, photos of ships are usually taken from angles that stop you from seeing where the falls are belayed. It is a problem for which I have no answer. The diameter of the line also is unknown.

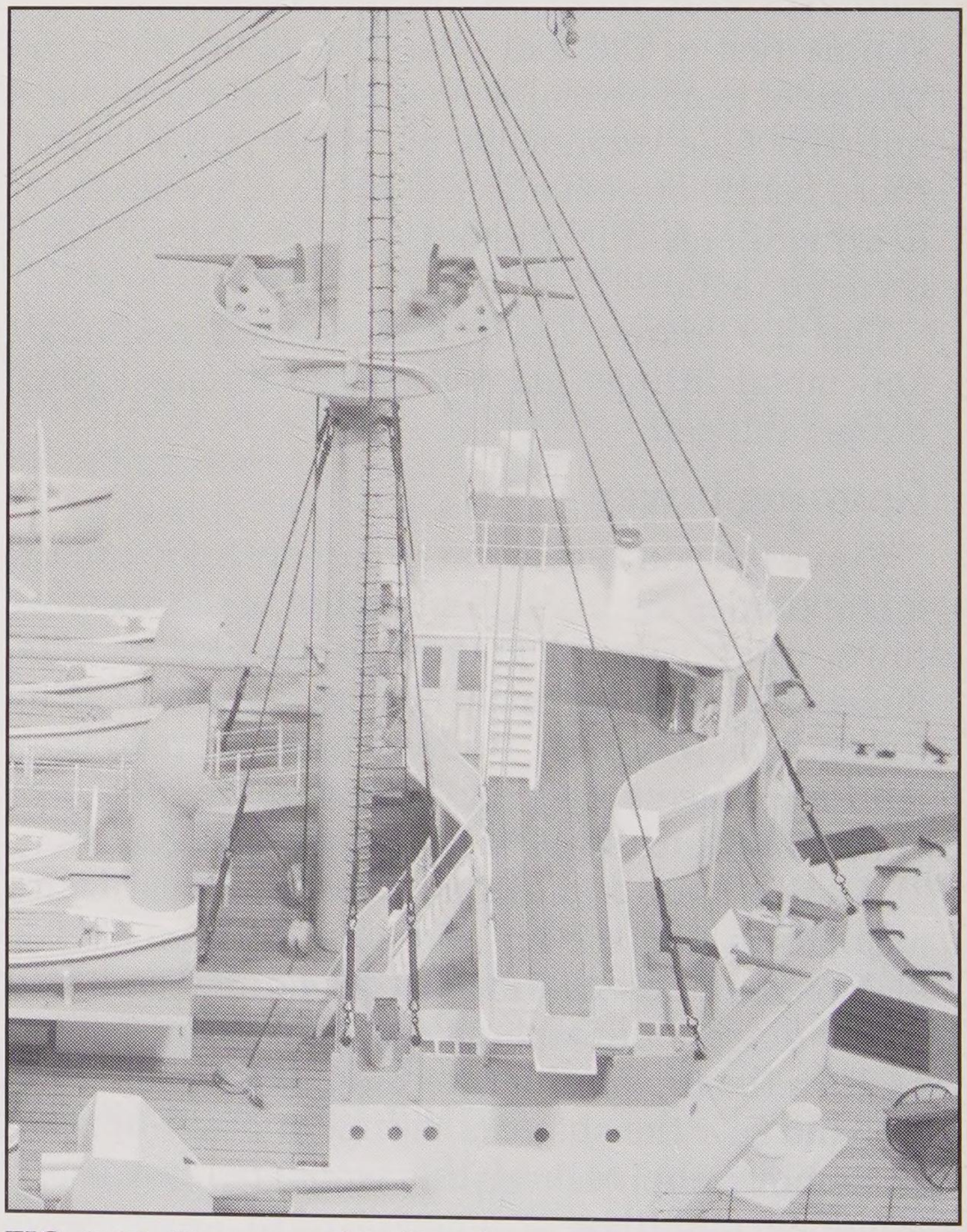


FIG. 6-11: *Empress of India's* foremast.

Fig. 6-11 shows *Empress of India's* foremast. **Fig. 6-12** shows one downhaul on this mast roved through two leading blocks to the winch. It seems the arrangement on *Duilio* must have been similar, leading the main downhaul to the winch in front of the deckhouse (**Fig. 6-13**). Examining the prototype's redrawn plans confirmed that no other winch was available for the job. Forgive me if my reasoning is incorrect, likewise, the use of naval terms. My excuse is that I am not a "top man," merely an "'umble modelmaker."

Fig. 6-14 shows some of *HMS Warrior's* (1860) rigging. Sails were still being used, which complicates the rigging enormously. **Fig. 6-15** shows the rigging on *Victoria's* single mast which is much

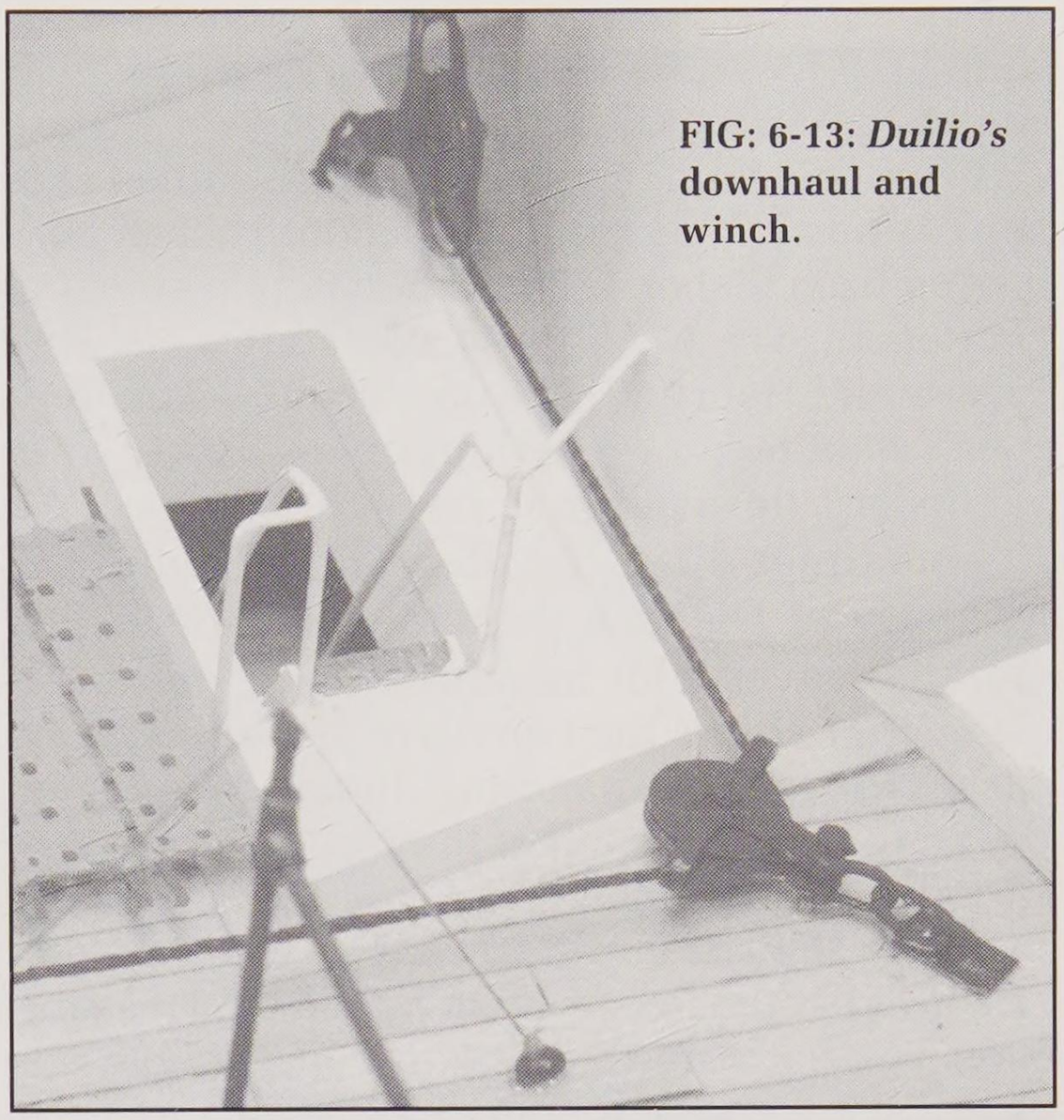


FIG: 6-13: *Duilio's* downhaul and winch.

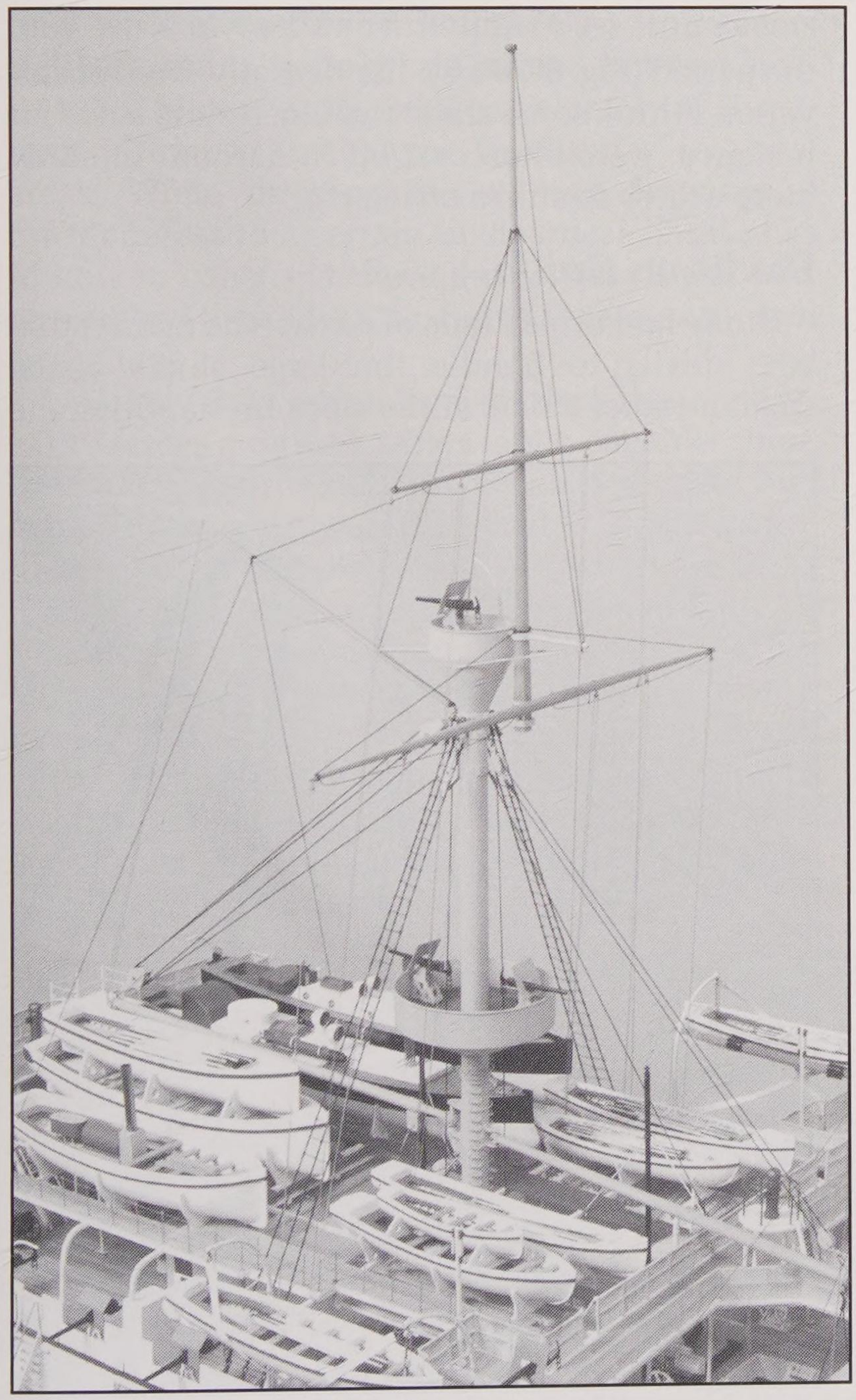


FIG. 6-15: Rigging on *Victoria*.

FIG. 6-14: Rigging on *HMS Warrior*.

simpler. The mainmast on *Empress of India* is shown in **Fig. 6-16** (c/s).

(*Warrior*, Britain's first and last iron-hulled warship, is now alongside in Portsmouth Naval Base having been elaborately and lovingly restored at Hartlepool. The Naval Base also houses Nelson's *Victory* and Henry VIII's wooden wall *Mary Rose*. If you want to know anything about Britain's Naval history, this is the one place to go.)

Sometimes a rigging plan is available with Ministry of Defence drawings, but even this usually leaves a lot unsaid!

Fig. 6-17 shows the two derricks rigged one on each mast for boat handling duties. The one on the mainmast to the left of the picture is rigged to carry the main weight, which it needs to be as it is handling the steam pinnaces. The foremast derrick is of lighter construction for obvious reasons. However, both are rigged with considerable mechanical advantage to reduce the load applied to the downhaul.

Fig. 6-18 shows the metal blocks at the masthead for the main derrick. Notice also the belaying points for the shrouds and other rigging. Similarly, **Fig. 6-19** shows the lighter constructed wood blocks at the masthead for the fore derrick.

Static rigging, such as funnel stays, does not require any description, as it is standard whatever

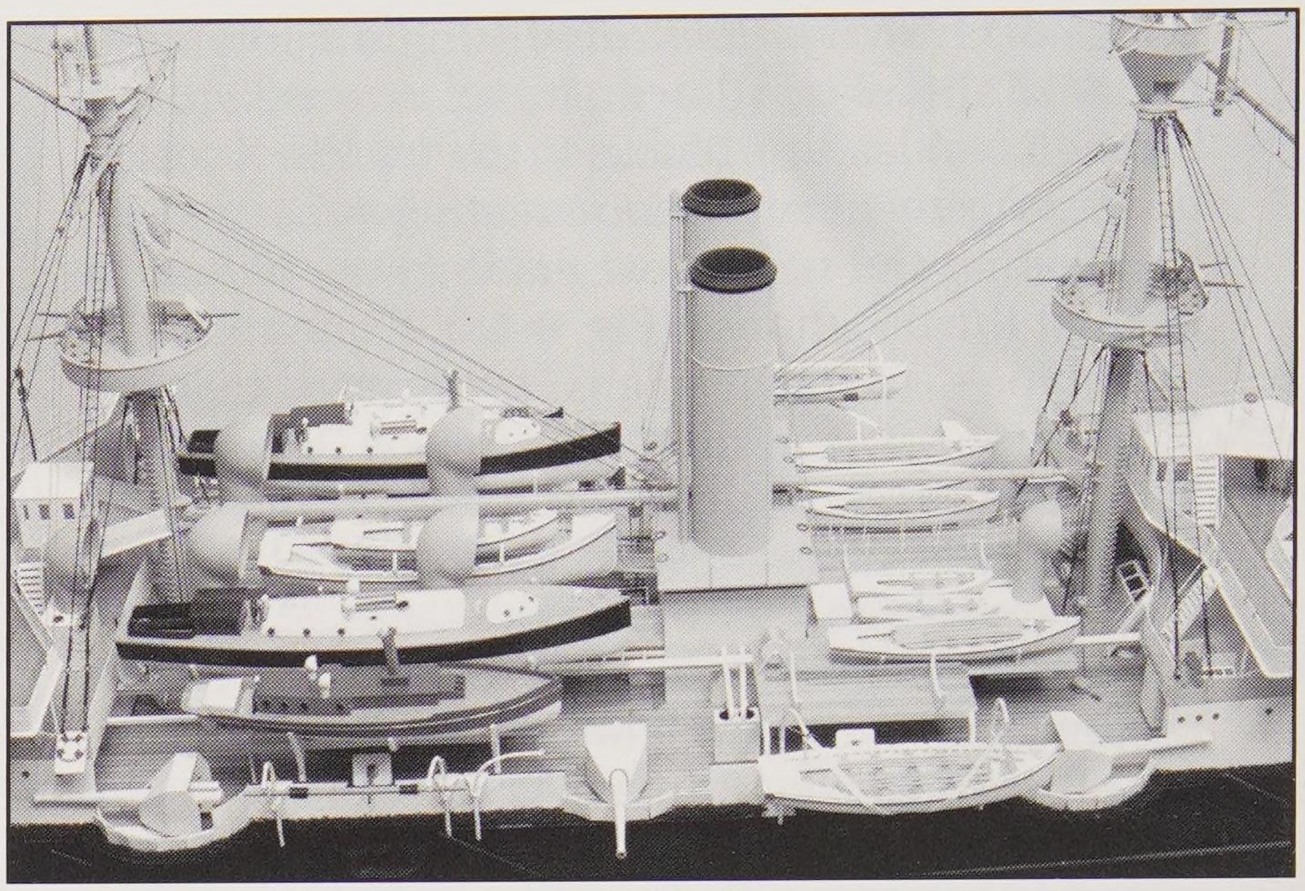


FIG. 6-17: Derricks on *Empress of India*.

the period (**Fig. 6-20** c/s). Incidentally, from observation I think some static rigging, funnel stays for instance, were often cast off in harbour to allow more access to ship's boats, etc.

Davits on *Duilio*

Duilio had three kinds of davits: the main radial boat davits to handle the large ship's boats, smaller radial davits at the stern for handling the

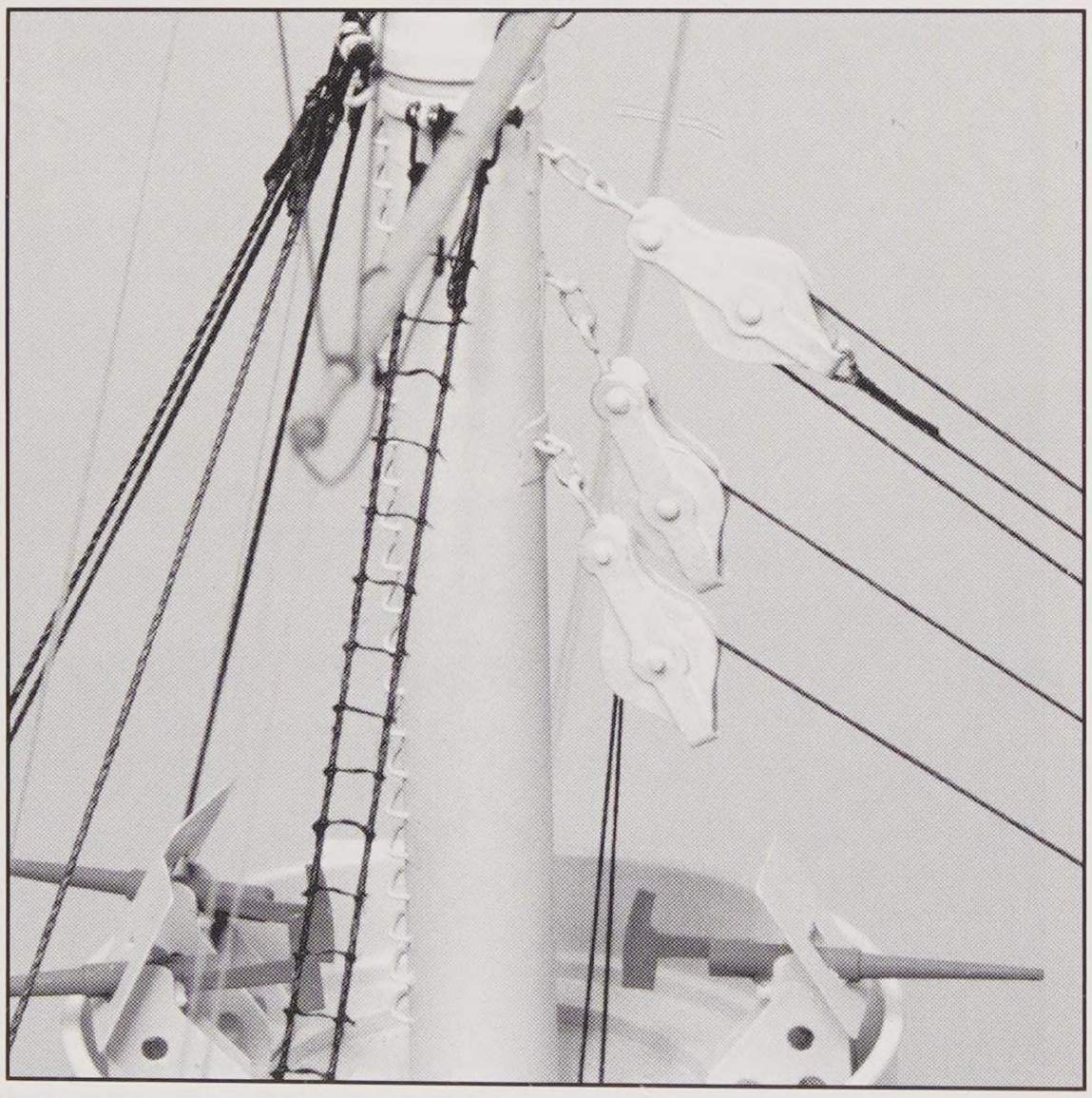


FIG. 6-18: Metal blocks on masthead.

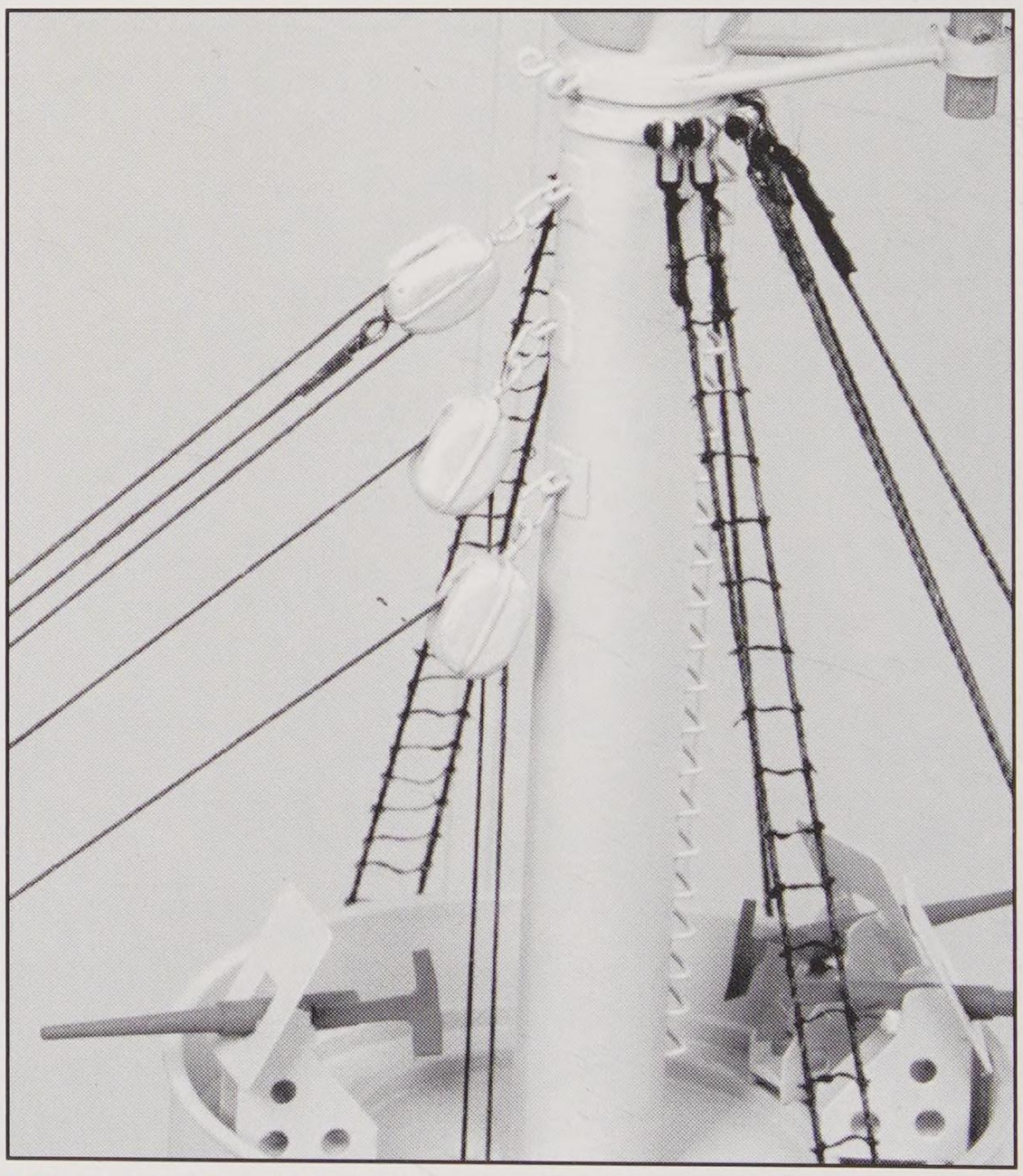


FIG. 6-19: Wood blocks on masthead.

smaller boats, and the very heavy anchor handling types. (These large main davits were of a different design to the ones used by the Royal Navy, which tended to use a boom attached to the mast for handling very heavy items).

Fig. 6-21 shows the main davit fitted to the hull. Four were required to handle the boats stowed on top of the turrets. For this reason, two each are abreast the starboard and port turrets. The type used on this vessel is not really typical, as a worm and wheel mechanism turns the davits inboard and outboard. Worm and wheels are self-locking and cannot be driven in reverse. The worm can drive the worm wheel, but not vice versa. The davits must be turned to outboard the boats.

The originals' actual design appears to show they were of cast construction. Cast iron seems unlikely owing to its brittle nature, but cast steel in 1876? However, the section is largely of H section, although it changes to circular in some areas. When drawing the etching drawings, I must confess to a certain unclearness of mind as to how to construct these davits. The lower part was etched to produce a tapered H section as well as the top.

Unfortunately, a time comes when sheer practicality forces a rethink. After much consideration, it was decided to turn the whole lower section from just above the top hull attachment point. This enabled the pivots and worm wheel to be made in one piece including the tapered foot. Although not an easy turning job, it had great advantages, not the least being that the top H section could, with cunning, be slotted into its top and secured with solder. It is an excellent idea to make freehand sketches of difficult bits – or any bits. It enables you to get clear in your mind what is required and helps formulate solutions.

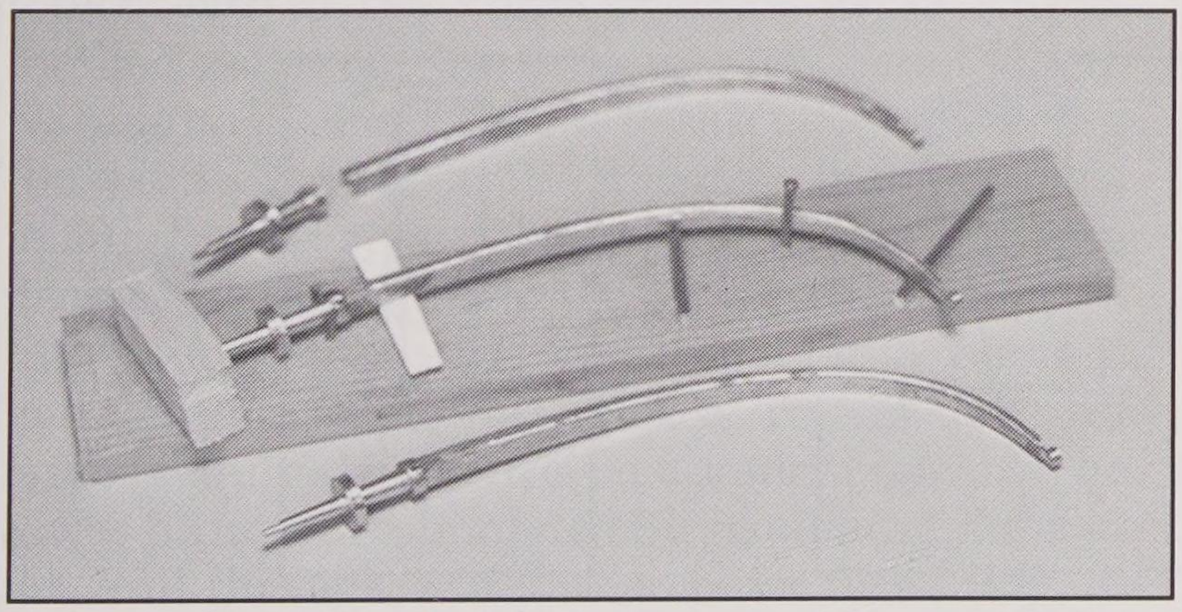


FIG. 6-23: Fixture for joining both parts of the main davit.

FIG. 6-21: Main davit.

The top section was soldered using three etched pieces to produce the davit's curved and tapered arm. The two flanges were left about 2mm longer than the web to fit into hand-sawn slots in the top of the lower turning. A fixture was made to hold both sections in the correct alignment for soldering (**Fig. 6-23**). Such fixtures, however simple, are essential to obtaining uniformity.

In typical 19th century practice, these davits were hinged just above the previously mentioned joint so they could be laid flat when going into action. This required filling in a short length of H section around the hinge with Isopon, then using a burr to shape the change of section. The hinge and flanges to bolt the hinge closed had to be added later as separate appliquéd pieces. This was necessary because the davits, if fitted whilst assembling the deck structures, would be vulnerable to damage and get in the way. Without these two pieces, the davit could be threaded through the top attachment ring, then seated in the lower bearing.

That was the idea. It failed to work, because the

FIG. 6-24
MAIN DAVIT LOWER ATTACHMENT PLATE

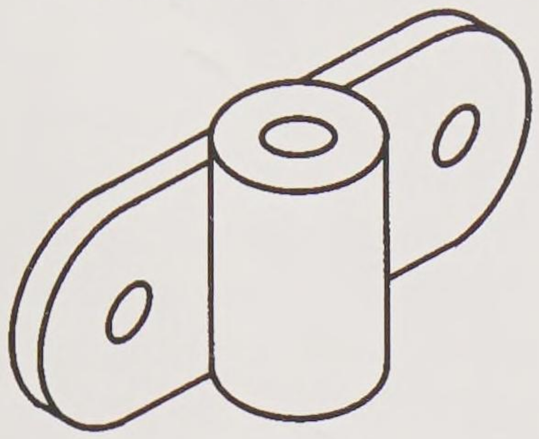
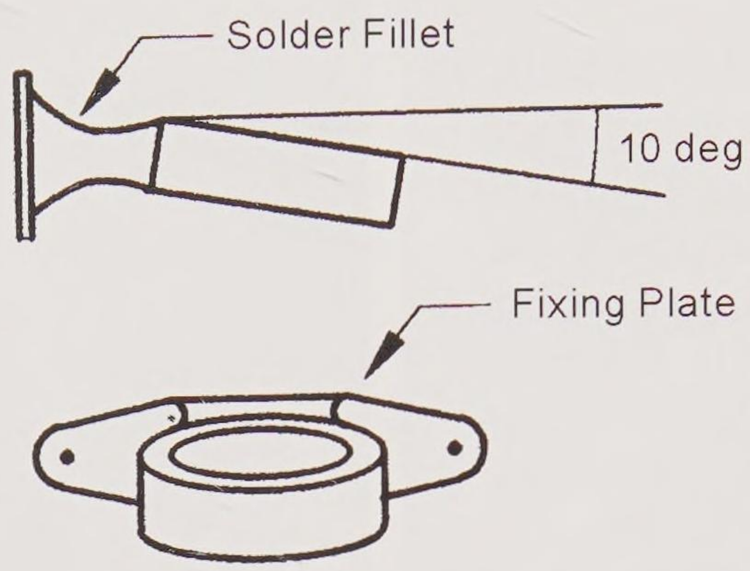


FIG. 6-25
MAIN DAVIT TOP SUPPORT RING



draughtsman omitted the protruding armoured belt on the detail drawing of the fitted davit. So, on fitting the davit to the hull, the angle was all wrong. To correct this, the top ring had to be packed out 1.5mm. It was found in practice that the davit could not be threaded up through the permanently fixed top ring as originally thought. It had to be loose, then the davit could be threaded through, and all finally secured. However, the lower fixing could be permanently attached on initial assembly.

It was hoped to affix all the hull fittings before painting to avoid complicating the job, but, that's life, one disappointment after another!

Two attachments join the davits to the hull mainly above the armoured belt. The lower footstep bearing attachment is shown fitted to the extreme top of the armoured belt which, I suspect, is wrong. Fixing to armour is difficult and would be avoided if possible. However, it is drawn that way, so the model was made as drawn.

The lower piece was simply a cylinder soldered to its fixing plate at an angle (**Fig. 6-24**). This presented no problem. The top ring was different (**Fig. 6-25**). A ring was fixed to its diamond-shaped plate not only at an angle, but 3mm from it. This is the sort of soldering job that causes grey hairs. Without a fixture (**Fig. 6-26**) to hold the two components in correct juxtaposition, the job would have been hopeless. The fixture was a wood block shaped with an "internal" right angle into which a birch dowel rod was fixed at the correct angle. This was equipped with an aluminium sleeve to support and locate the ring. (Aluminium was chosen to resist soldering.)

The diamond-shaped brass support plate was fixed horizontally to the vertical face at the correct height. A 2mm thick by 3mm wide copper strip filled the gap. It was first soldered to the support plate before the pre-tinned ring was located on the dowel. The whole joint was then flooded with solder. If a daub of Baker's fluid is used, the solder will form a neat fillet more easily than just relying on resin cored solder. The excess copper strip was then cut off and a round file waved around the joint to clean it up.

The reason for using a long rather than a short strip was to control it whilst soldering. Soldering small discrete parts is impossible, as control is totally lost. The real secret behind making this type of assembly is *total* control at all times. You cannot do this work freehand, however much you try. It is always worth the time and effort to make a fixture or jig. (If you do not know the difference, refer to my first book, *Advanced Ship Modelling*.) Such fixtures can be made of wood, as the usage will be small. If made for soldering, the wood will scorch, but this is usually of no great matter.

FIG. 6-26
TOP SUPPORT RING ASSEMBLY FIXTURE

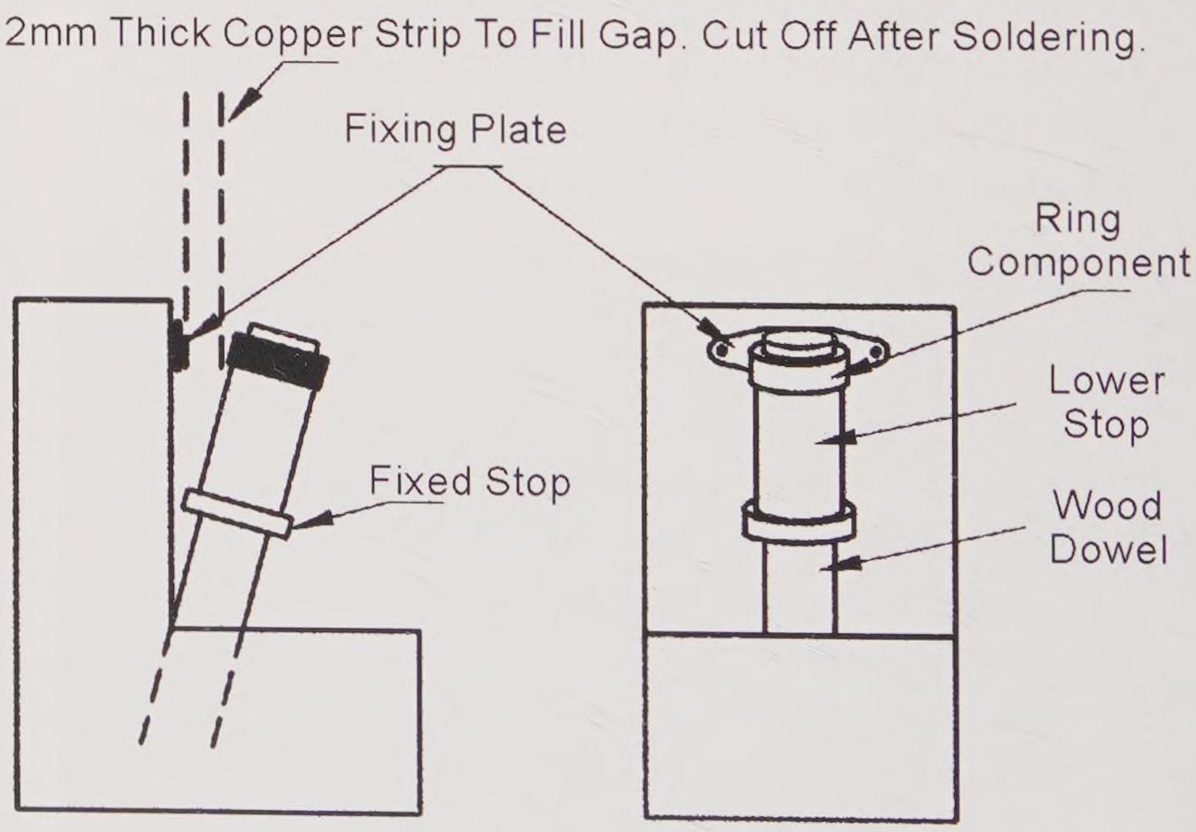


FIG. 6-27
SMALL RADIAL DAVIT

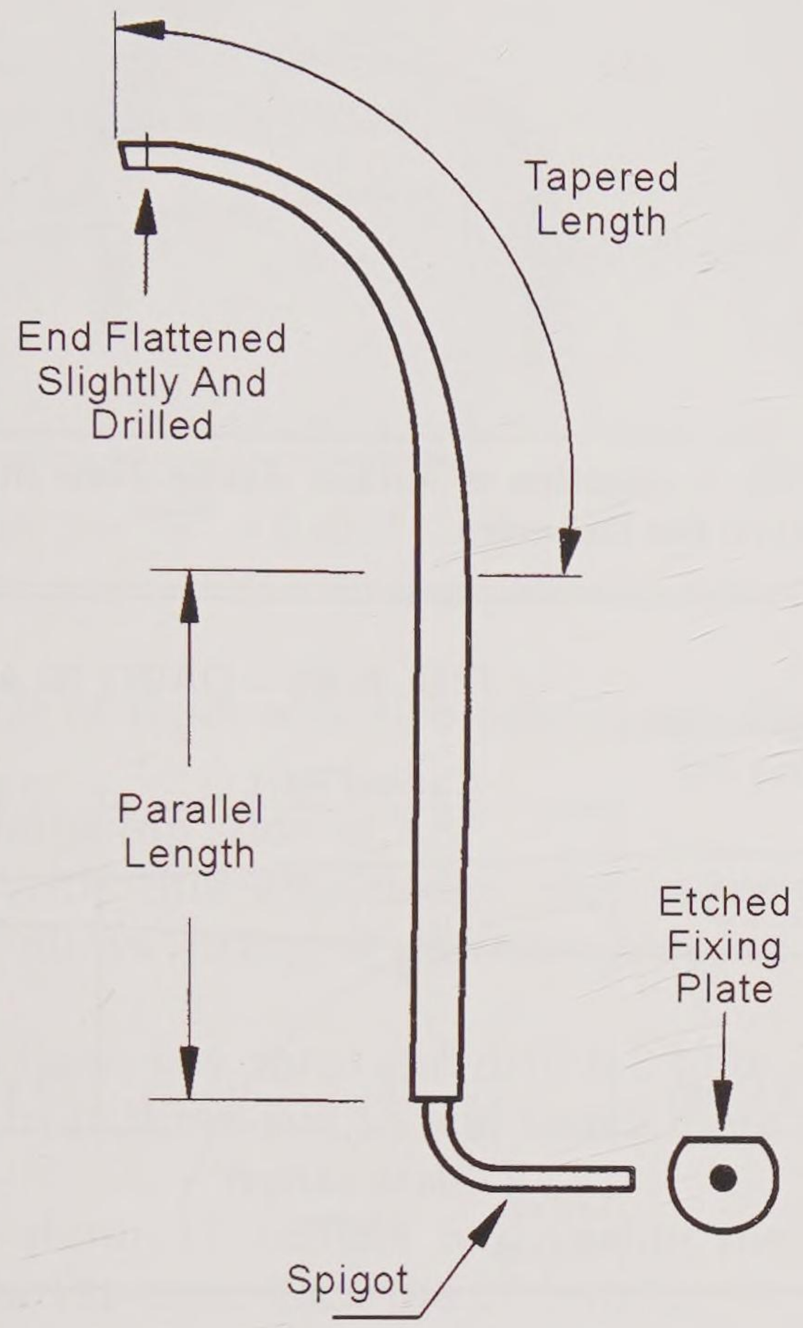
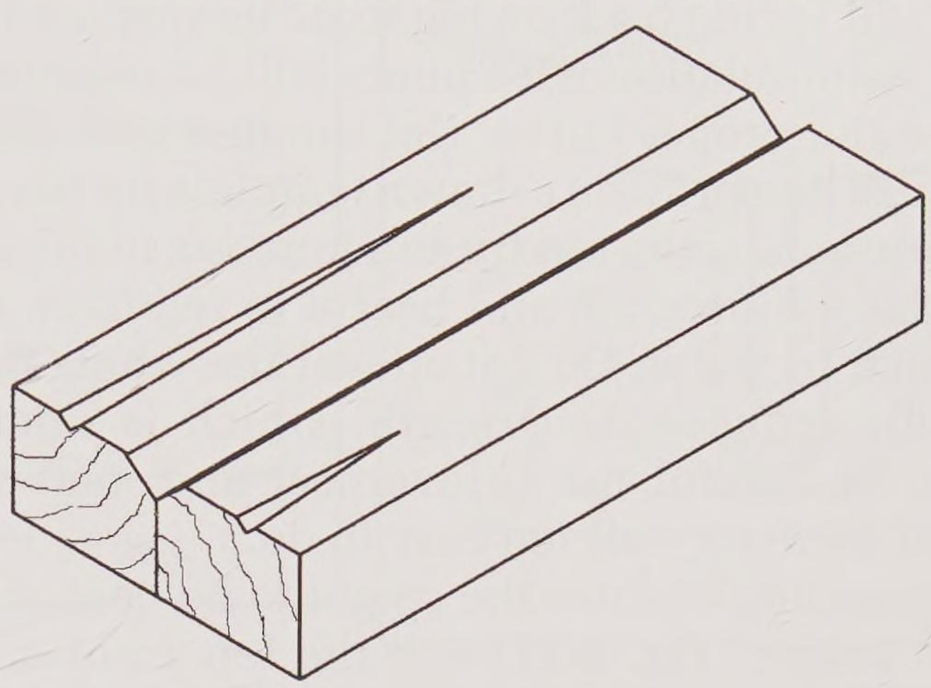


FIG. 6-28
MAST AND DAVIT SHAPING BLOCK



Small davits on deckhouse

Besides the four complicated main davits, *Duilio* required 16 smaller radial davits of the same pattern. Eight were on the deckhouse and eight surrounded the quarterdeck. Davits, although usually a small item, demand careful work if they are to look authentic. They must be tapered (if the originals were) and not left parallel, which is the easy way out but always looks wrong.

Bronze welding wire of 1/16" diameter was used. It was cut to the correct length using a fine-toothed metal cutting fretsaw. The overall length was found by using a piece of soft wire bent round the davit's profile on the drawing, then adding a length for the spigot that went into the hull and deckhouse. In real life the lower end would fit into a footstep bearing as, being a radial davit, it had to rotate in the vertical axis. However, it will not be required to do this on a static model, so the lower fitting was simulated by an etching glued to the hull through which the spigot fitted (**Fig. 6-27**). Cheating, I know, but in a good cause!

The davits were made as follows: Each length was held in the lathe and the spigot turned down to 0.76mm diameter by 5.5mm long. This diameter was about as small as was practical. Using a Myford ML7 lathe on such tiny jobs presents difficulties. Firstly, holding small diameter rod in the standard three-jaw chuck is impossible, as the jaws do not close down that far. The work has to be held in a pin chuck which, in turn, is held in the three-jaw chuck. This multiple holding job usually destroys close concentricity mainly because the pin chuck is not accurately made. If you obtain a good one or any accurate collets, guard them with your life; their price is above rubies. Incidentally, collets should have three jaws, but cheap ones have four because it is easier to make them – two cuts instead of three – think about it!

Coming back to the spigot, conditions must be right for such small diameter turnings to succeed. Tools must be stoned sharp, set at the correct centre height, and used with wee small cuts. Minimum work and tool overhang are essential. I used my digital readout facility to check the diameter, but also checked with a micrometer before unchucking.

The top end taper was filed on using a vee wooden block (**Fig. 6-28**) described in *Advanced Ship Modelling*. The taper was filed on with the davit held in the pin chuck so it could be slowly twisted whilst lying in the groove. Use a coarse file at first to remove the material, then a finer one for a better finish.

The next operation was to put in the curve.

Clamp a bar of a diameter considerably smaller than the required curve in the vice, then hand bend the davit around it. Unfortunately, the material will spring back owing to its temper, and further manipulation with pliers will be required to make the proper curve. Get the first one correct and use it to provide a drawn template for the rest.

Now anneal the top tip and junction of the spigot. Use a blowtorch and heat it to red heat, then quench in water. Do *not* anneal the whole davit, as this reduces its strength, which is undesirable. Be careful not to overheat and melt such small sections – all too easy to do.

Annealing enables the spigot to be bent at right angles (**Fig. 6-27**) and the top 2mm of the davit's tip to be flattened prior to drilling Without this flattening, drilling the requisite 0.5mm hole is difficult. After flattening and centre popping, re-anneal the tip to remove any work hardening this may have caused. Boring small holes, especially in drawn rod where the metal is work hardened, can be difficult and likely to break drill bits, so any steps preventing this are welcome. Broken drill bits not only lose the bit, which at that size are almost impossible to resharpen, but also the component.

A friendly firm with a spark eroder can remove broken drill bits and taps. In fact, it is the only way to remove high-speed steel (HSS) tools, but a 0.5mm diameter drill bit?

When boring small holes, applying a coolant – or even water in a pinch – is helpful, and use a fixed drilling machine instead of a handheld drill. If you are using a piece of wood packing, it's a good idea to clamp it to avoid any movement. The object is to remove, as far as possible, any side loads on the drill bit. Unwanted side loads, accidental or not, are a prolific source of breakages.

Anchor davits

Fig. 6-29 shows a collection of unpainted anchor davits. The reason for these davits is explained in chapter 11. *Duilio's* seem to be of a heavier construction than in Royal Navy ships. Two main problems have to be overcome in their manufacture, taper turning the blank and bending it to shape. This requires a ductile material and copper was chosen.

Too much material must be removed on these heavy davits to make filing the preferred method. In any case for accuracy, turning is the best option. If the stock is held in the three-jaw and the tailstock supports the free end, the setup's geometry stops you from positioning the top slide near enough without a great deal of tool overhang. That is likely to produce mega chattering and hence a bad finish. To overcome this:

Measure an anchor davit's straight portions and the curve's mean radius from the original drawings (**Fig. 6-30**).The length of the unbent davit was calculated as follows:

Using the mean radius of the curve, its developed length of arc was calculated thus: (All dimensions in mm.)

$\frac{90^o}{360} \times \pi D$ where D = 2 x 17

(It will be one quarter of a complete circle.)

Substituting figures: $0.25 \times \pi \times 34 = 26.7$

This figure was rounded to 27 (**Fig. 6-30**).

The total developed length then becomes:

8 + 13 + 27 = 48mm

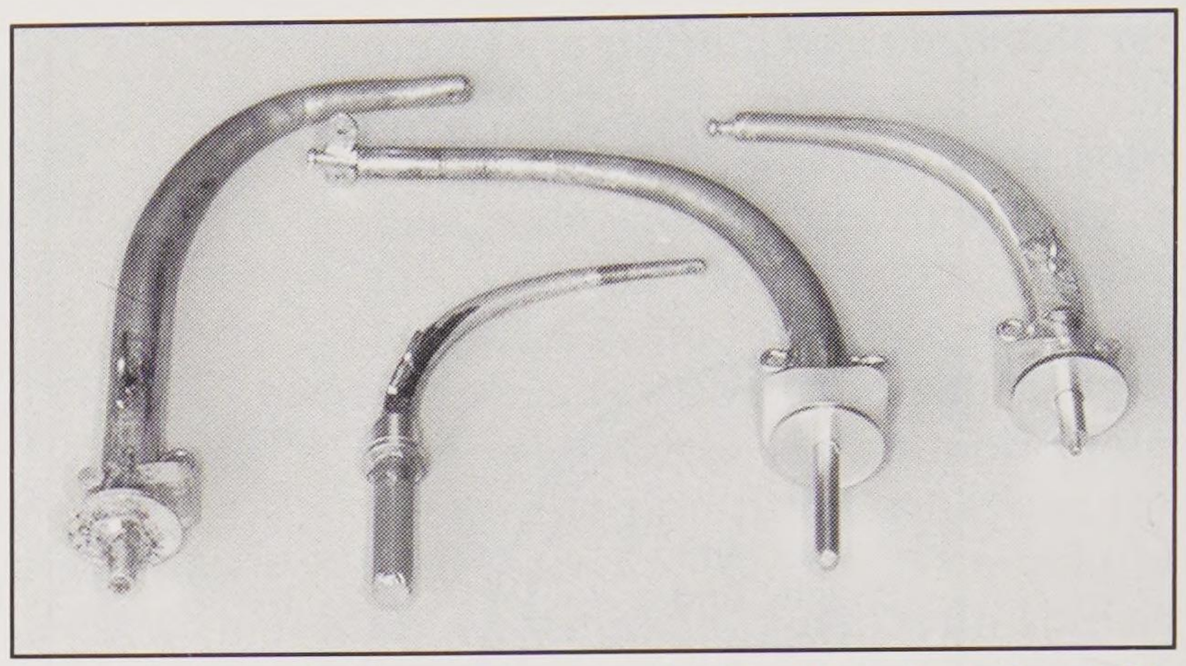


FIG. 6-29: A selection of anchor davits. Note that the right-hand davit has flat sides.

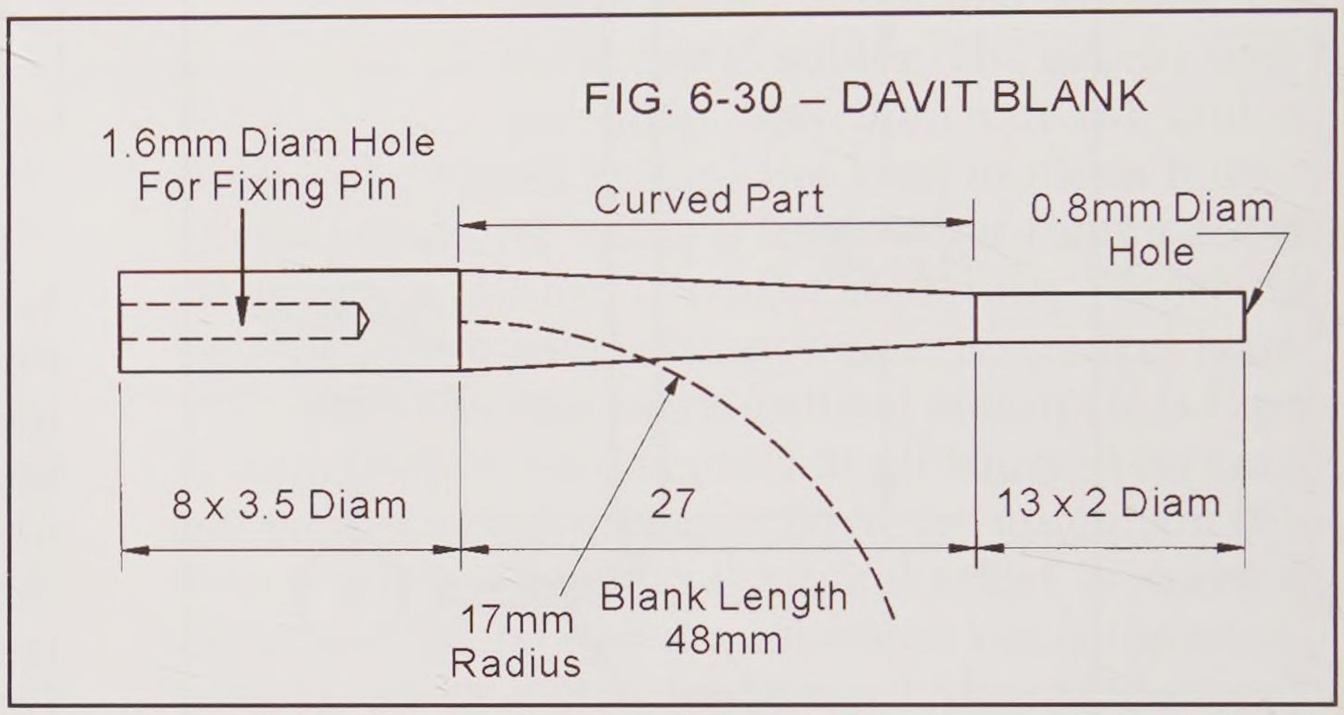


FIG. 6-31
CALCULATION OF TAPER ANGLE

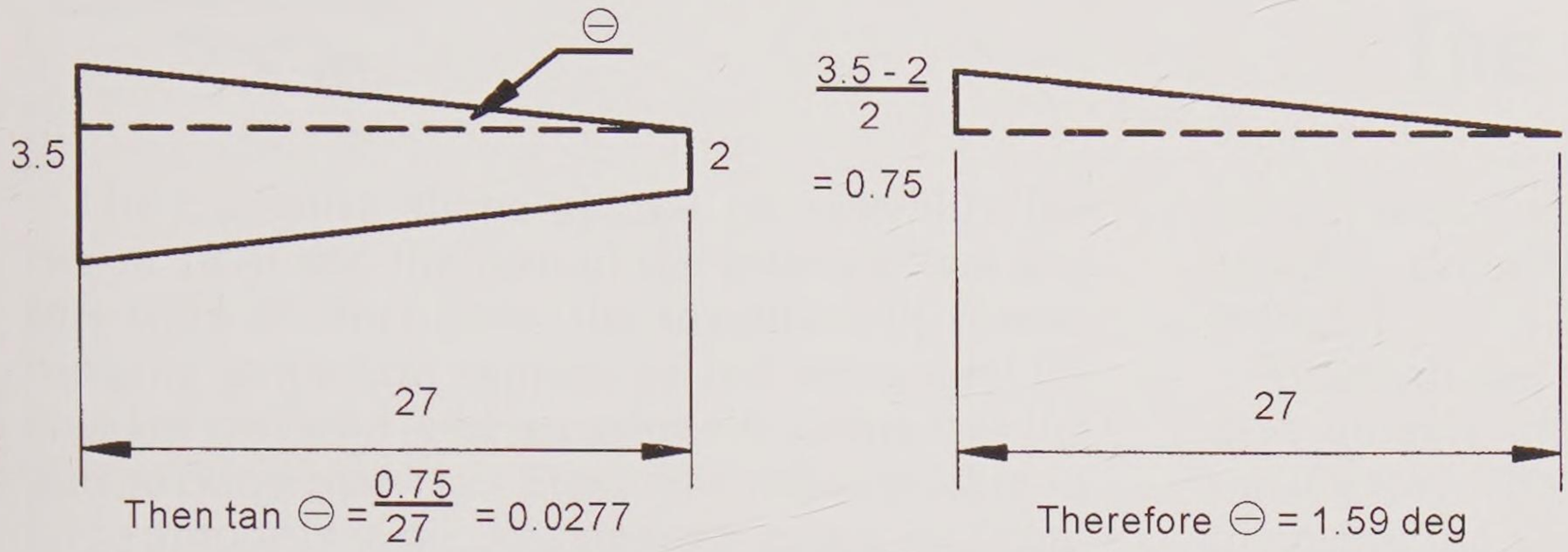
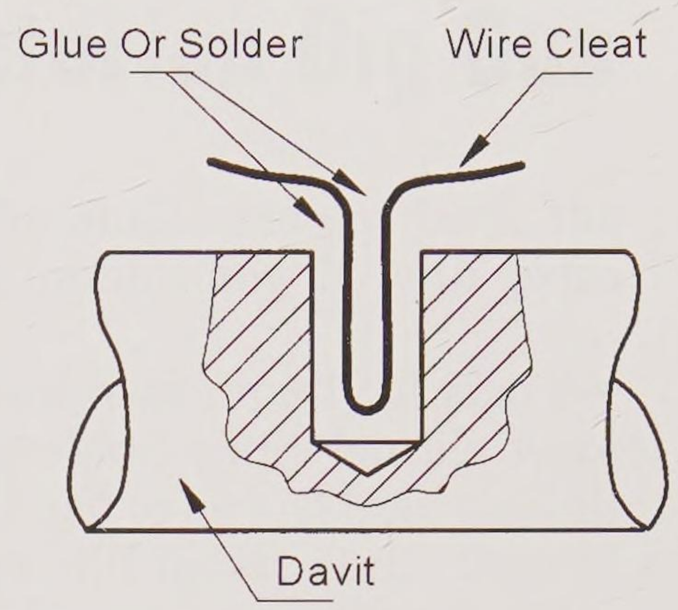


FIG. 6-32
CLEAT CONSTRUCTION



The angle of taper was also calculated (**Fig. 6-31**).

Set the lathe top slide to 1.6°.

Armed with this knowledge, the operations were as follows using 4 diameter copper bar stock:

1) Hold in three jaw, face, and drill 0.8 hole.
2) Extend from three-jaw 15 and turn 2 diam x 13 long.
3) Extend about 12 further and, using the top slide, start to taper turn the 27 length.
4) Extend the stock until the 27 length is complete (this can be done in two or three stages as convenient).
5) Turn 3.5 diam parallel and part off 8 long.
6) Reverse, hold on 3.5 diam, and drill 1.6 diam hole for fixing pin.

Although the tapers can only be machined using the top slide, the parallel dimensions can be machined using the autofeed.

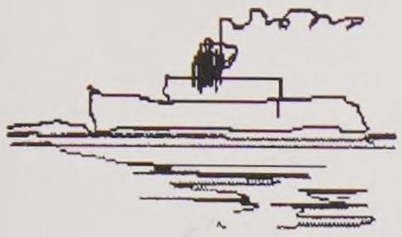
If free end support can be used; i.e., you can get your tailstock up and engaged, do so. However, the above procedure will enable you to complete the job without tailstock support, as only a minimum amount of stock is projecting at one time.

Points to watch

1) When turning the taper, make sure you do not get a groove caused by tool "dig-in" at the junction between the taper and the 2 diam. This will look unsightly and produce a weak point when bending to shape.
2) Try to anneal (heat to bright red and quench in water) only the length to be bent.
3) When bending, fill any axial holes with drill shanks or pins to avoid crushing or distortion when clamping in the vice. In our example, protect the 13 straight section with a tube (I clamped it into a detached drill chuck) to prevent unwanted bending.
4) With the base end firmly clamped in a vice (protect if necessary), start bending at the *thick* end of the taper, i.e., the base. Left to its own devices, it will bend at the thin end first. It is essential to establish the bend at the "difficult" end first; the remainder will then be easy.

All the davits were made from copper rod except the last pair, which were brass (I run out of stock). They were a success despite the doubts mentioned at the beginning of this description. Complete annealing enabled the curve to be bent without cracking.

The various fittings were then added. The foot part was shaped Perspex cyanoed on, and the hinge a piece of 1/16" brass rod half buried in the back face and soldered. The cleat(s) was a brass wire bent into a "T" and fitted into a hole, soldered, and cleaned up (**Fig. 6-32**).



Chapter Seven

The Victorian Big Gun

The big gun's shape altered considerably between 1870 and the turn of the century. Two factors were at work here, the invention of slower burning propellant explosives and using steel instead of cast iron (and occasionally bronze) as the gun making material. Steel was not available in large amounts until Bessemer invented his "converter" in 1855. This was followed by the open-hearth process about 10 years later. Before that, steel was used mainly for making springs. It was manufactured in small quantities first by the cementation process, then by the Huntsman method.

How did these two facts change the big gun's shape? When gunpowder explodes, it does so violently, which rapidly raises the pressure in the gun's chamber. Great *tensile* strength is required to prevent the gun from bursting, particularly at the breech. Although cast iron is strong in compression, it is weak in tension. The only way to overcome this weakness is to increase the amount of metal resisting the stress. Hence the very large breech ends on early Victorian weapons (**Fig. 7-1**).

The large muzzle swell on early cast iron cannon was to stop the muzzle from exploding. At any point along the barrel, the area behind the projectile is subjected to the force of the explosion, but the barrel is also being supported by the part in front of the shell. This extra support no longer exists when the shell emerges from the muzzle, necessitating reinforcing it with extra material.

Although the pressure rises rapidly, it also decays quickly and, therefore, short barrels were satisfactory. The barrel had to be just long enough to ensure the shell was still inside at the time of maximum pressure. A barrel longer than that increased unnecessary frictional resistance as the projectile moved up it.

Gunpowder was used at this time for blasting and as a propellant explosive. Some attempts were made to slow the speed of the pressure rise by reducing the gunpowder's surface area. Fine powder has an almost infinite surface area, which was reduced by pressing it into blocks. Oscar Parkes in his *British Battleships* (Seeley, Service and Co. Ltd.) cites the following categories of powder in use at that time as "Slow burning cocoa S.B.C., Prismatic brown P.BR., Prismatic black P.Bl., Small pebble S.P., and Rifle large grain R.L.G."

Further work by Nobel and Abel, amongst others, produced ballistite, a smokeless propellant explosive of nitroglycerin and nitrocellulose. Nobel patented it in 1887. Abel's research into the properties of guncotton led to the development of cordite in 1889.

The pressure rise was slower with these explosives and, therefore, a longer barrel was required to ensure the projectile benefited from the maximum pressure attained. At the same time steel, with its greater tensile strength, became the constructional material. All of which resulted in a longer, slimmer weapon.

Fig. 7-2 shows the shape of three 19th century guns. The top one, a typical weapon from *HMS Victory's* era, is a smooth bore 24-pounder that fired a spherical

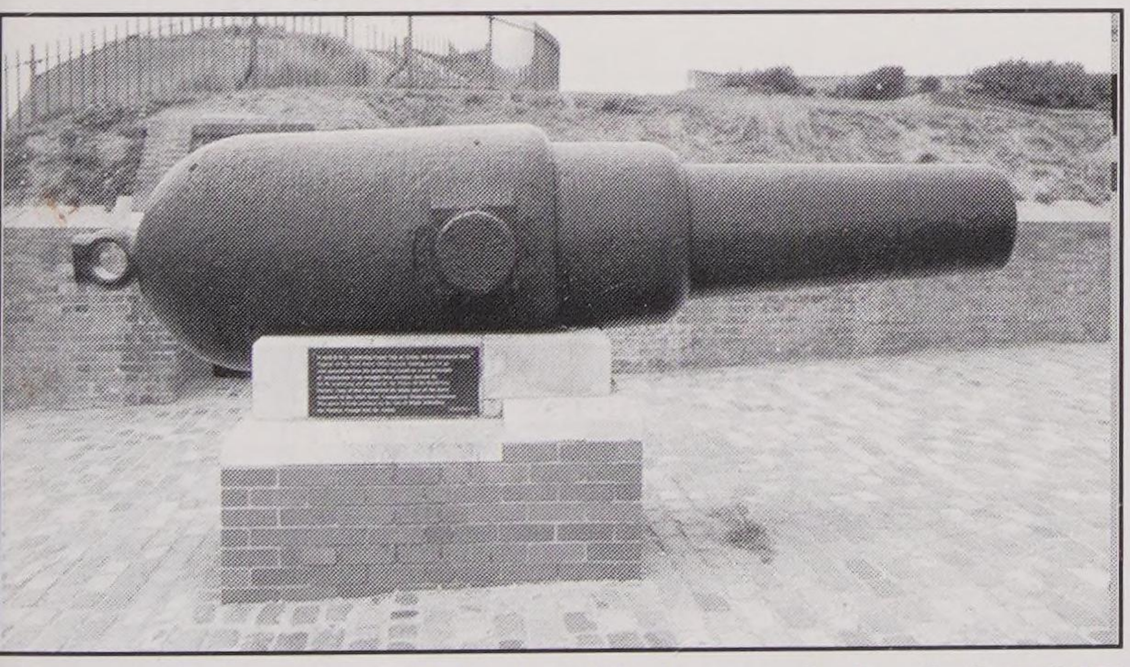


FIG. 7-1: A 12-ton 9-inch rifled muzzle-loaded MkIII Armstrong Fraser gun of 1868. Its shape is typical of cast iron gunpowder-charged weapons of the period.

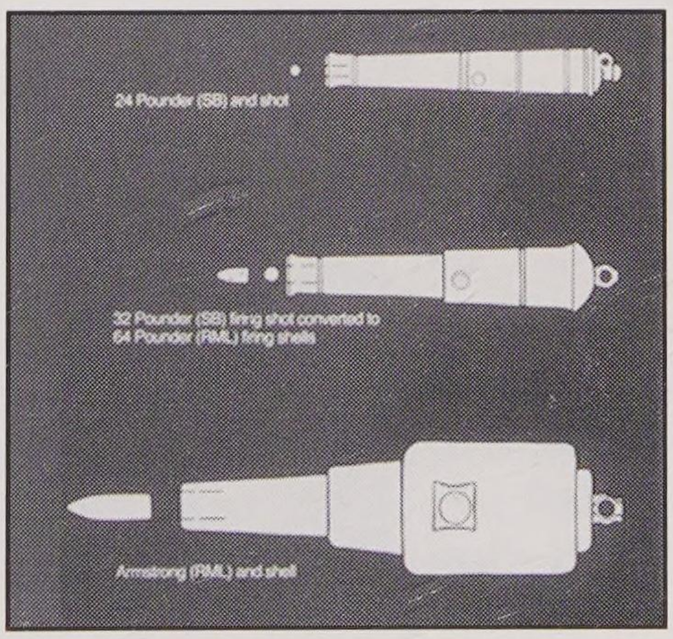


FIG. 7-2: The shape of three 19th century guns.

shot. The centre one, a 32-pounder smooth bore, was converted to fire a 64-pound cylindro-conical studded shot that matched rifled machined grooves in the bore. It was still a muzzle-loader, but the extra weight of the heavier, longer shot increased its penetrative power. The bottom one, an Armstrong rifled muzzle-loader circa 1870, is the sort of weapon that started the period under review.

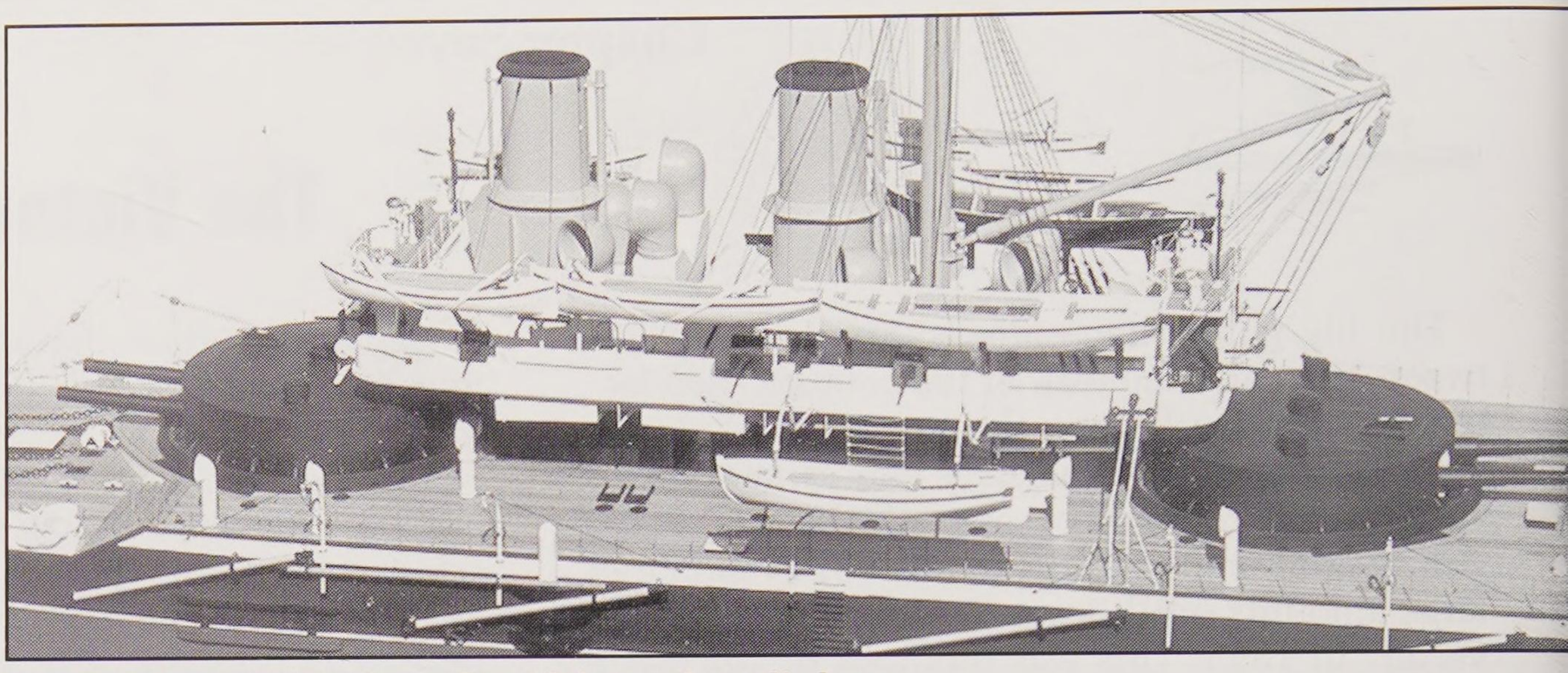


FIG. 7-4: *Devastation* after refit with longer barrelled guns.

The visual effect of these changes was quite dramatic. *Devastation*, as launched in 1871, had four 35-ton muzzle-loading rifled guns whose muzzles just protruded from the turret face (**Fig. 7-3**). After her refit in 1891-'92, she was re-armed with 10-inch breech-loading 29-ton weapons that stuck out about half the diameter of the turret. This improved the look of the ship enormously (**Fig. 7-4**). Incidentally, whatever the period, it is very important to get the muzzle swell correct. Its shape can be subtle, particularly with 20th century guns, but it contributes a great deal to the model's "atmosphere."

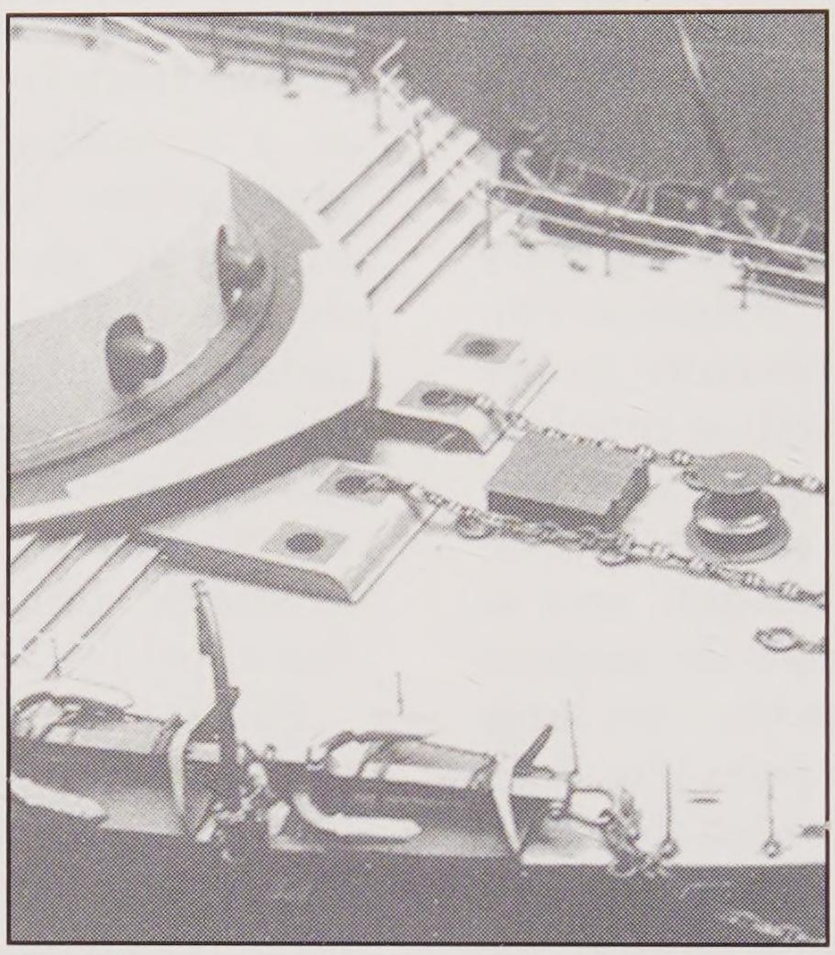


FIG. 7-3: A model of *Devastation* showing the original short barrelled guns.

Turrets and barbettes

Turrets and barbettes were in use during the period in question. In modern naval practice, the armoured turret normally sits and revolves on the fixed barbette. A *turret* is an armoured house for one or more guns. A *barbette* is the fixed armoured tube below the turret that leads down into the magazines and shell rooms. It contains the ammunition hoists and, at the top, the turret's roller bearings.

Early battleships up to and including the *Cyclops* class were turret ships with a relatively low freeboard. However, *Alexandra* reverted to a battery ship with armoured citadel rather like *Warrior* (1860). When launched 7/4/1875, she carried a main armament of two 11-inch and ten 10-inch muzzle-loading rifles. Her two subsequent refits changed this to four 9.2-inch breech-loaders and eight 10-inch muzzle-loaders. **Fig. 7-5** (c/s) shows *Warrior's* 100-pounder Armstrong rifled breech-loader. **Fig. 7-6** shows the bow gun with its brass racers on the deck, which allowed it to fire through the netted embrasures on either side. Unfortunately, the

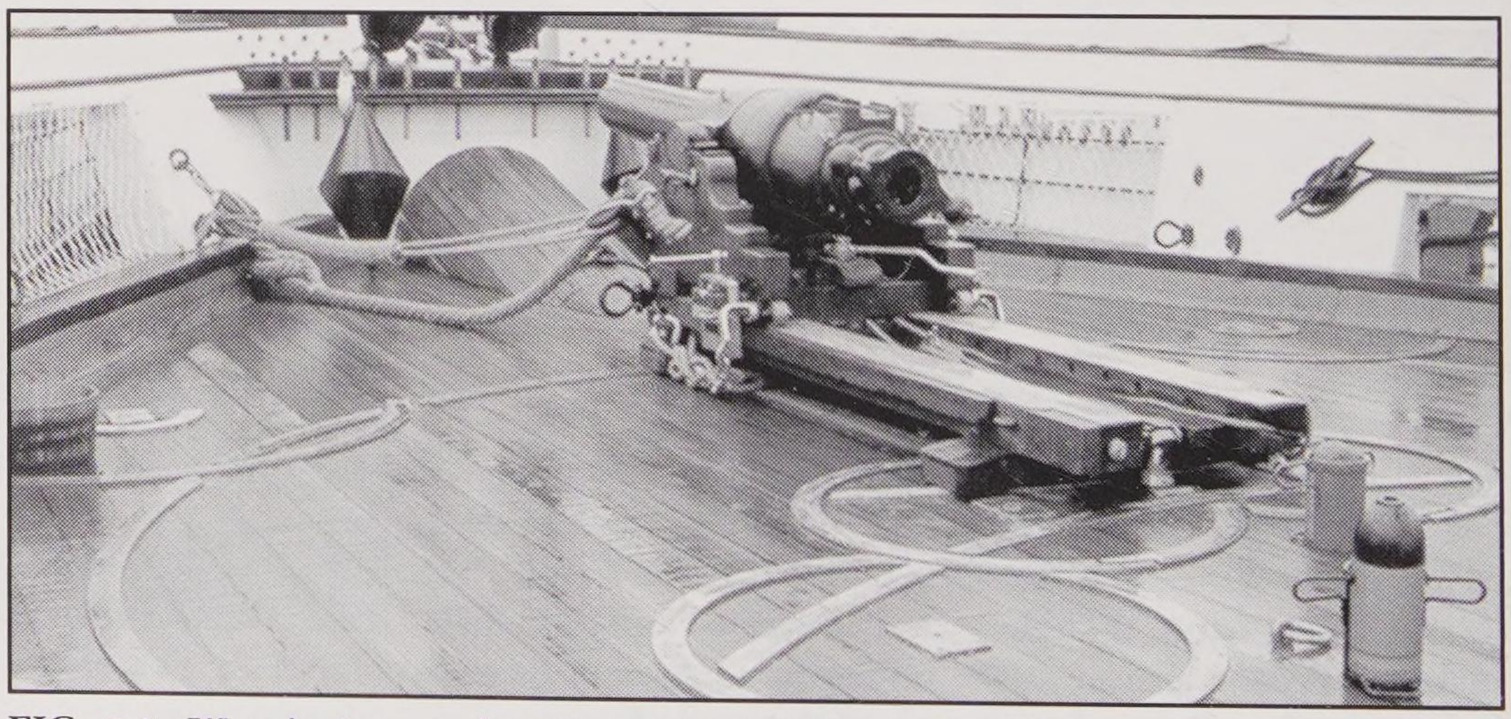
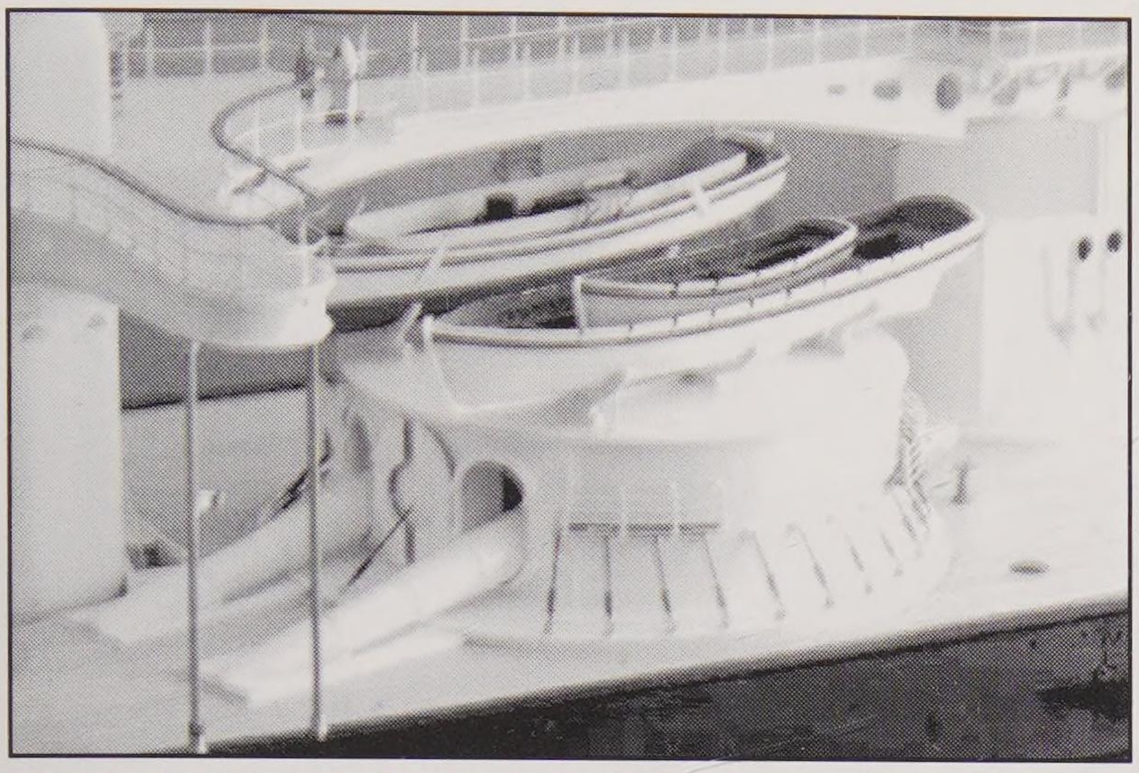


FIG. 7-6: *Warrior's* gun showing racers and rope tackle.



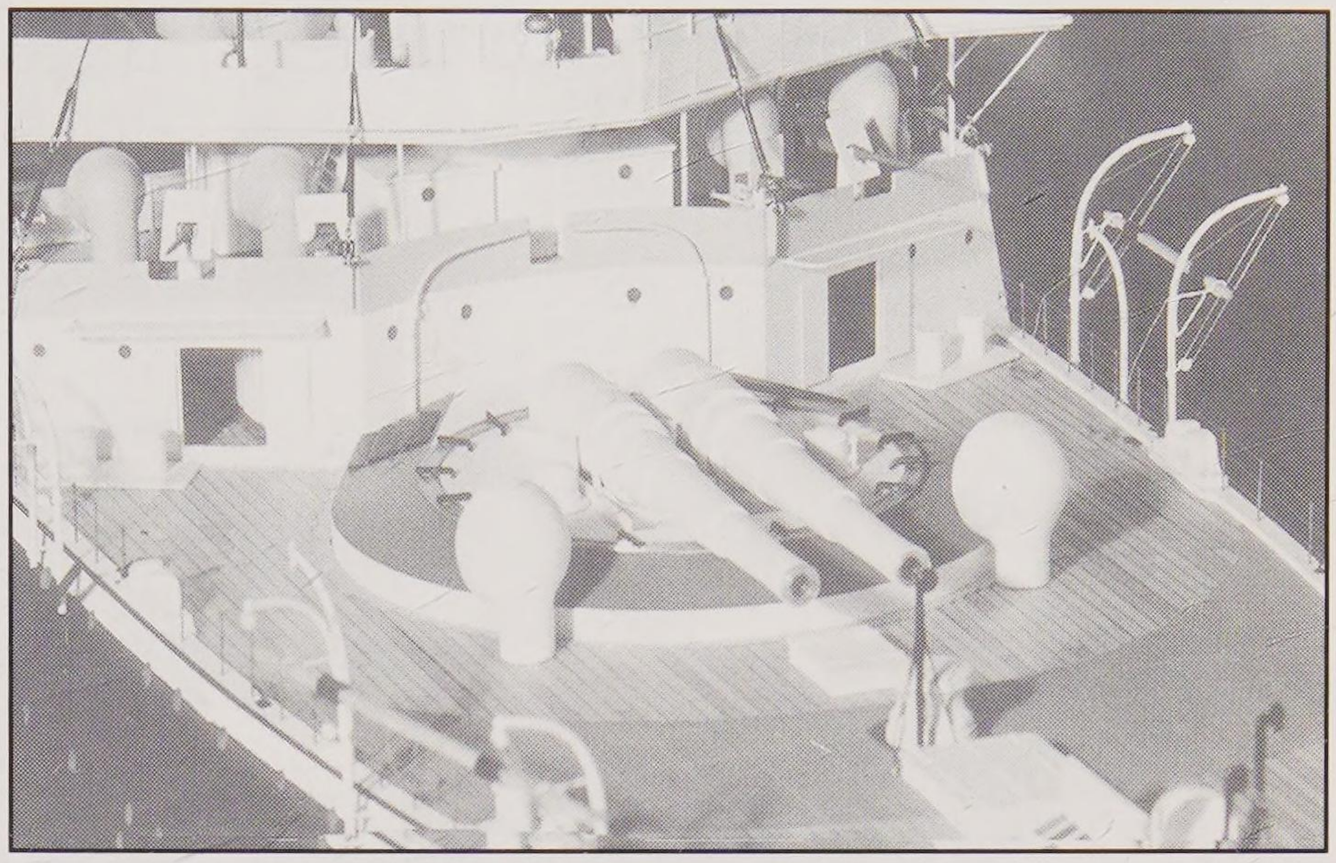


Fig. 7-7 (above): *Duilio*'s starboard turret in the loading position. FIG. 7-8 (right): Open guns on *Empress of India*.

breech-loading mechanism on the Armstrong gun failed and muzzle-loading returned in the RN.

The terms *muzzle-loading rifle* and *breech-loading rifle* must be explained. Cannon of Trafalgar vintage were smooth bore, muzzle-loading weapons that fired a spherical cast iron shot. For a given bore size, the only way to increase a projectile's weight was to employ a cylindro-conical shape; i.e., the shape of a modern shell. Increasing the weight helped the shell's penetrative power if it could be prevented from tumbling over and over, which it did when fired from a smooth bore.

The answer was to spin the shell by putting rifling grooves in the bore and fitting the projectile with studs that engaged the grooves. To load these guns, shells were hoisted up in front of the muzzle within the turret. After charging the weapon with powder, the shell was engaged with the rifled grooves and rammed home. Later on, ramming from below the decks was used. **Fig. 7-7** shows *Duilio's* starboard turret in the loading position. All these manoeuvres took time and slowed the rate of fire. External ramming enabled a smaller turret and saved much weight.

The problem with armoured turrets was their weight. High freeboard ships held this weight very high, thereby reducing the vessel's stability. The turret weight for the seven *Royal Sovereign* class ships was such that all were finished with their guns in open barbettes which, to modern eyes, looks strange. Only *Hood* was finished as a turret ship, which was largely due to the influence of the Sea Lord, Admiral Sir Arthur Hood. Although the most handsome of the class, her freeboard was lower than the others, she lacked seagoing abilities, and her stability was inferior to the rest.

Fighting the guns in open barbettes probably lacked appeal to the gunners. One problem for the modeler is that few pictures are available showing the breech mechanism fitted. It would seem that this was stored elsewhere and only fitted for gun practice. Another feature is that the barrels were secured to a tilting "tray" with inverted U-shaped straps held tight by tapered pins/bolts. The tray acted as the gun cradle, taking care of the recoil and vertical aiming – rather a nice modelling feature. **Figs. 7-8** and **7-9** (c/s) show *Empress of India's* (*Royal Sovereign* class) guns mounted on the barbette with no turret protection. The breech mechanism is not fitted for reasons mentioned above. It is rare to see a photo with this mechanism in place. Also note the sealing ring, which prevents water entry, sitting on the glacis plates. The short black lines are the fixing brackets holding the ring to the gun housing's moving part.

The *Admiral* class had a similar arrangement of open barbettes. *Benbow* carried a massive 110-ton gun in each open barbette. Her sisters, *Anson, Camperdown, Howe*, and *Rodney*, had two 13.5-inch, 67-ton breech-loading guns. How effective the 110-ton gun would have been in practice with only one round fired every four to five minutes is open to conjecture, but the ship would make a fine subject to model.

The two-ship *Victoria* class ships, *Victoria* and

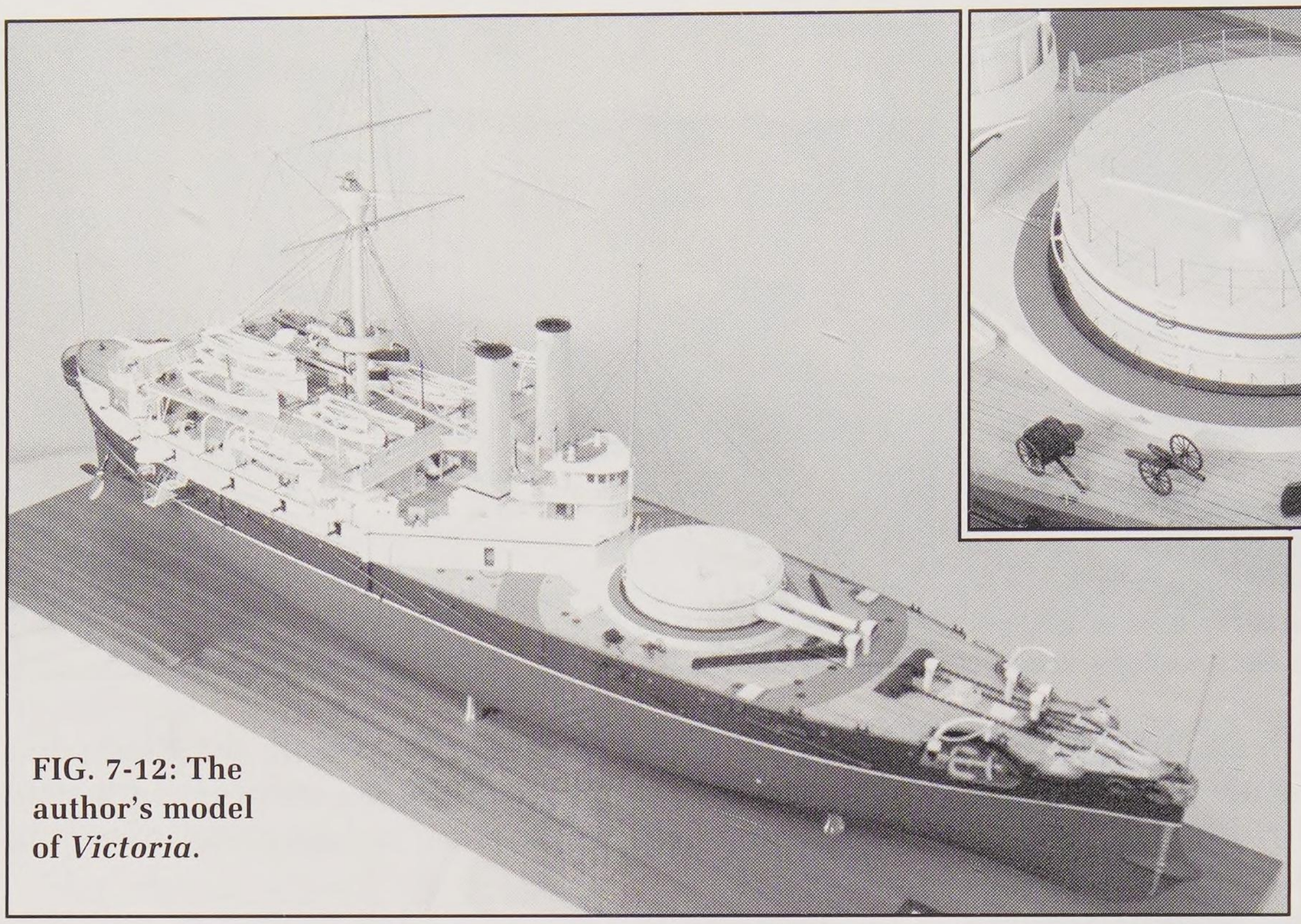


FIG. 7-12: The author's model of *Victoria*.

FIG. 7-10: *Victoria's* two 16.25-inch 110-ton breech-loading guns in the fore turret.

Sans Pareil, are also quite distinctive. The loss of the *Victoria* after a collision with *Camperdown* is well known, being the worst naval tragedy to that time. It is dealt with fully in Parkes *British Battleships*. Both ships had an unusual layout with one large turret forward housing two 16.25-inch, 110-ton breech-loading guns (**Fig.7-10**) and only a 10-inch, 29-ton breech-loading gun aft (**Fig. 7-11** c/s). Note the horseshoe-shaped receptacle for hammocks – a real wooden wall feature. In addition, a battery of 12 6-inch breech-loading guns were mounted in the manner of a "wooden wall." They make interesting models as **Fig. 7-12** shows.

Two other aspects of the Victorian turret should be discussed. Modern turrets are armoured all over because of the danger from plunging fire at extreme range. Since no naval battles were fought between Trafalgar and Dogger Bank, it was assumed that naval actions would be fought line of sight with the expectation of only near horizontal trajectories. World War I saw the use of much greater ranges than had been expected, and horizontal surfaces, decks, and turret tops became vulnerable to plunging shells. This development, however, was in the future and Victorian turrets had no real overhead protection. *Duilio's* turrets, for instance, had glass roof skylights exposing the gunners to attack (**Fig. 7-13** c/s).

Even the *Majestic* class ships of 1895 had turrets with large rectangular holes in their roofs that were sealed by a flimsy, possibly wood, canvas-covered enclosure. All this was supported by removable beams so the guns could be removed. It might have kept the rain and sea out, but little else! **Figs. 7-14** and **7-15** show the fore turret on my model of *HMS Magnificent* (*Majestic* class) with its canvas cover.

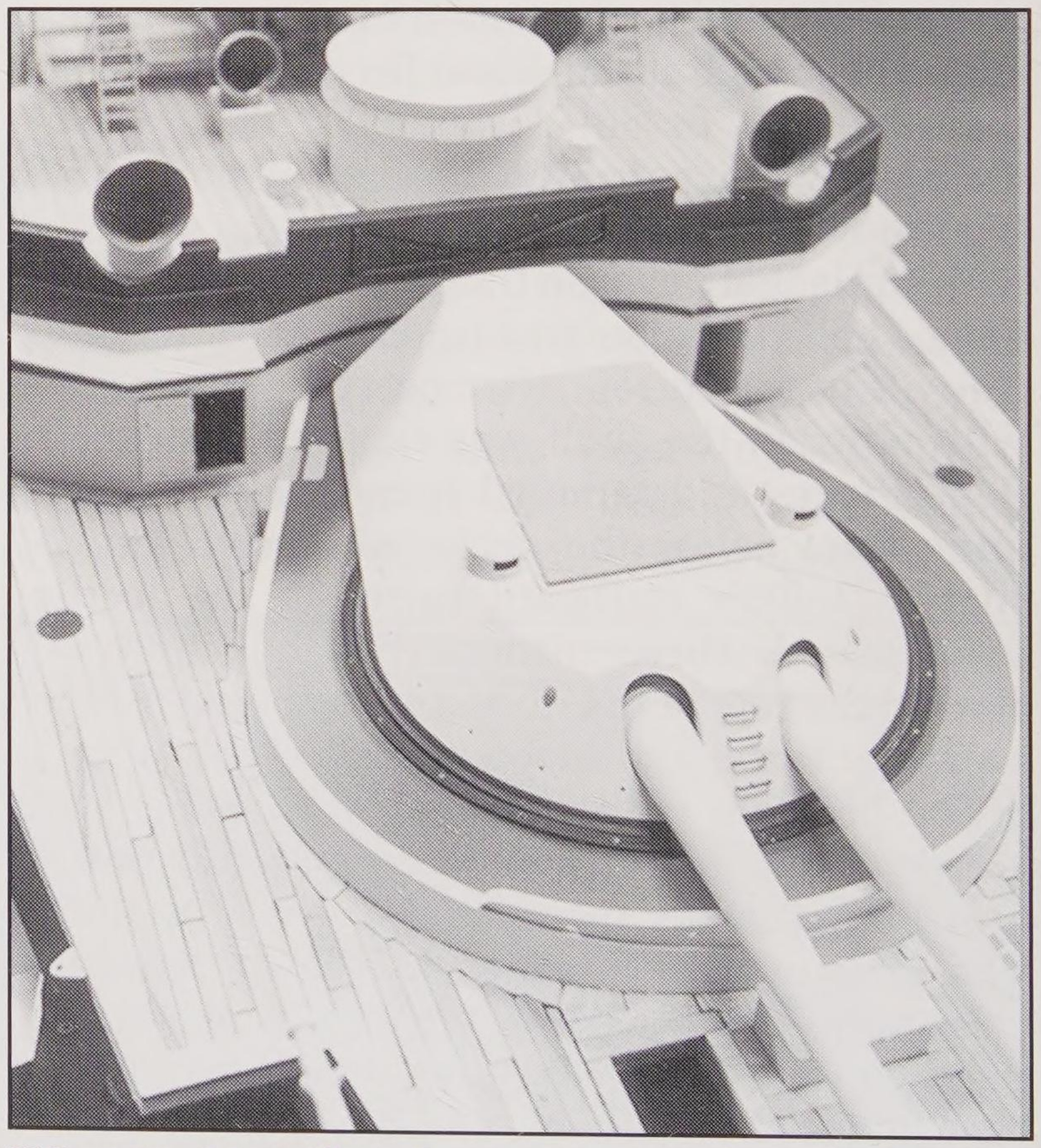


FIG. 7-14: *Magnificent's* canvas-covered turret. Note the cam around the fore edge of the glacis plate to prevent the guns from firing into the ship's structure.

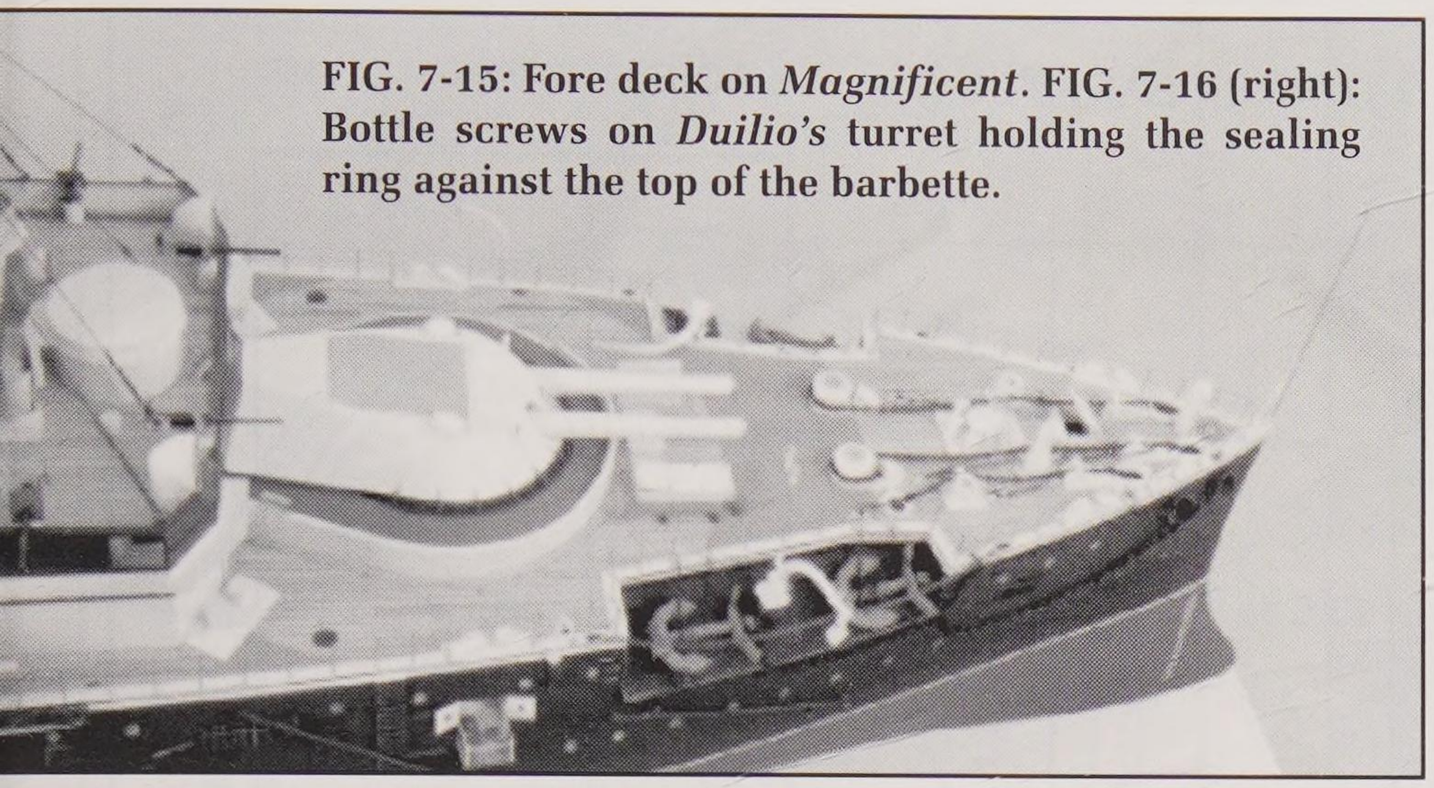
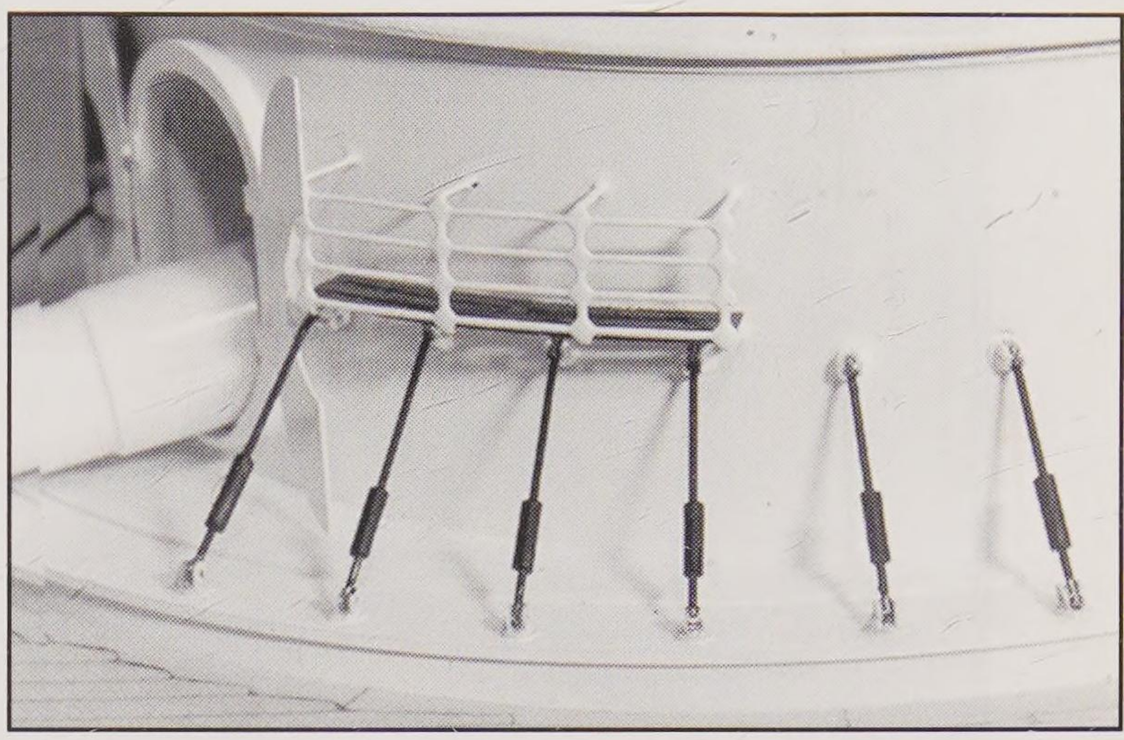


FIG. 7-15: Fore deck on *Magnificent*. FIG. 7-16 (right): Bottle screws on *Duilio's* turret holding the sealing ring against the top of the barbette.



The other problem the Victorians tackled was how to prevent water from seeping under the turret and into the barbette. In many cases this was solved by fitting a flat ring around the turret just above deck level and holding it to the turret side with bottle screws (turnbuckles). A leather gasket sealed the annular, horizontal gap between turret wall and ring. Bottle screws enabled the ring to be adjusted closely onto the deck to eliminate the gap. **Fig. 7-16** shows this scheme on *Duilio*.

Figs. 7-17 and **7-18** show the machining drawings for *Duilio's* gun barrels. It is a good idea to prepare such a diagram before attempting any manufacture. Note the use of trigonometry for determining the taper turning settings. (If you have forgotten your trigonometry – a most unlikely occurrence of course – draw the barrels out to scale and measure the angle with a protractor). This job really requires a lathe. The alternative, using nesting (telescoping) tubes if you can find them, makes a poor substitute and always lacks the essential taper. Incidentally, no effort was made to finish the breech, as it was hidden by the turret.

Turrets for *Duilio*

Fig. 7-19 shows *Duilio's* gun turrets. The left one is the port turret with its guns fixed. The right turret has its guns mounted on a "trunnion" with the pin going right across the turret. The breech ends of these guns were made of wood, as no Perspex of the right size was readily available. Since they could be seen through the barrel openings, they had to be there.

At first glance, *Duilio's* turrets appear circular in plan, as were the turrets for *HMS Inflexible*. This sort of simplicity is a joy for model makers; circular turrets can be turned on the lathe.

However, closer scrutiny revealed *Duilio's* tur-

FIG. 7-17 – PORT TURRET BARRELS (X2)

(Barrels were fixed into the turret and did not need the breech end or trunnions.)

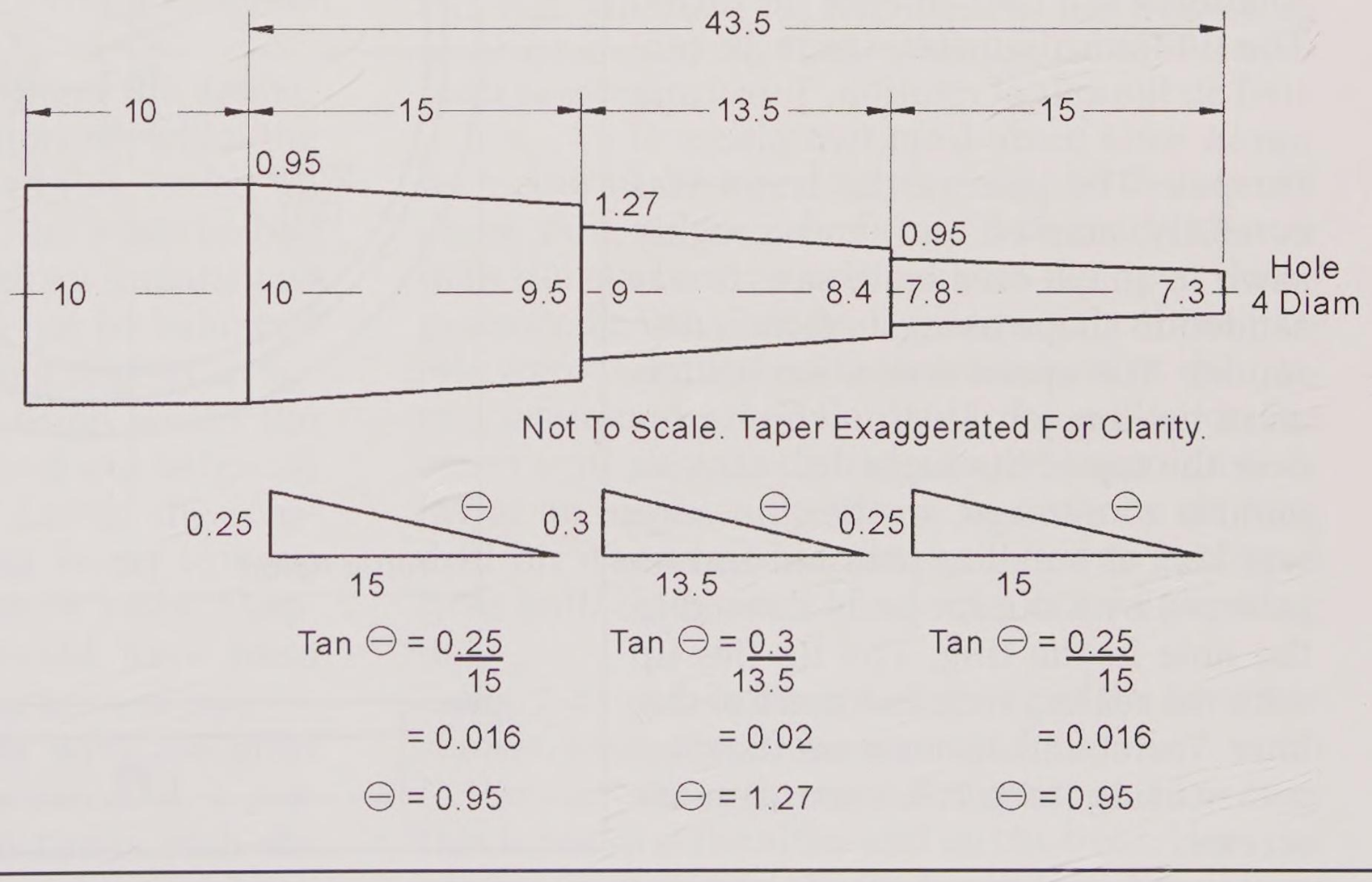


FIG. 7-18 – STARBOARD TURRET BARRELS (X2)

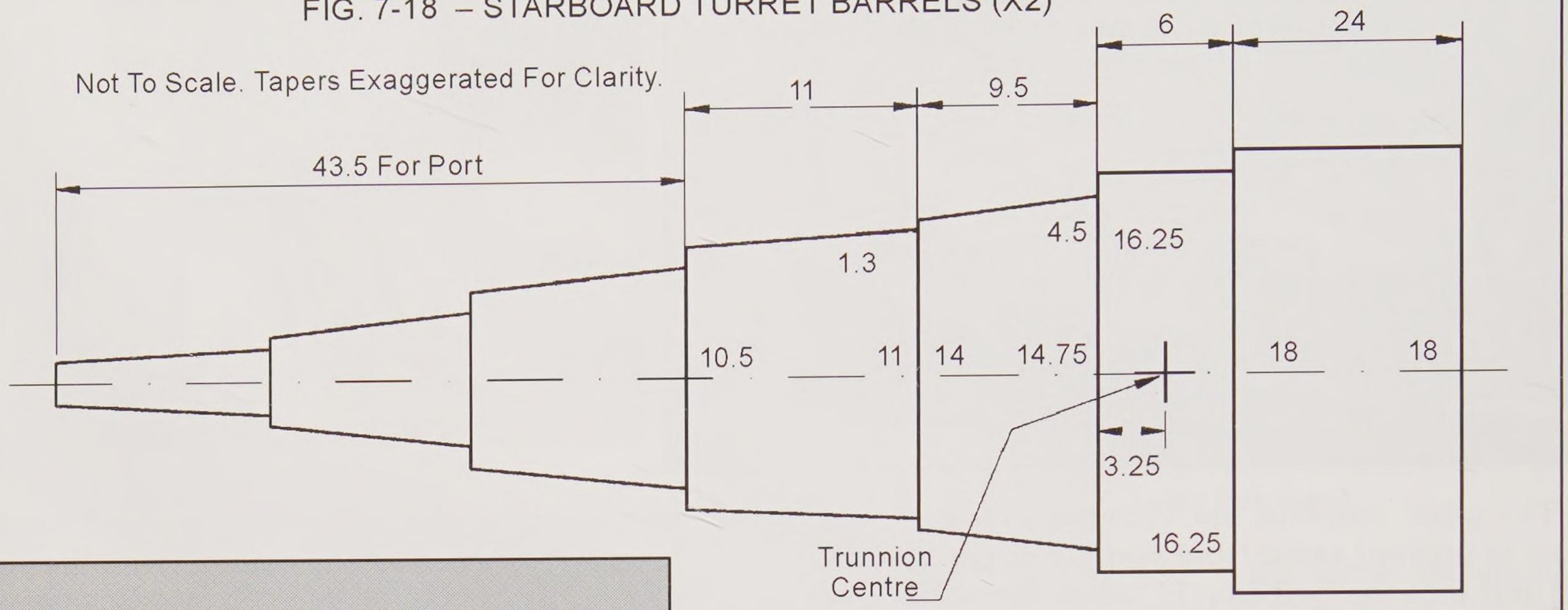


FIG. 7-19: *Duilio's* gun turrets.

rets were made of four joining curves. **Fig. 7-20** shows the geometry of the turret and apron. Note that the axis of rotation is not the centre of the turret. The 118mm diameter apron is centred on the axis of rotation. Turret and apron were made from two pieces of Perspex. The plan of the turret was carefully marked out and roughly sawn to shape on a band saw. It was sanded to shape using an 8-inch disc sander. The apron was a straightforward turning job. Its lip, which runs over the top of the barbette, was vulnerable to damage, so the thin edge was kept as small as possible and reinforced by a thicker body housed in the hole in the ring. The lip ties up with the sealing ring, but more of this later. Turret and apron were fixed together using three 10BA countersunk screws.

FIG. 7-20
TURRET GEOMETRY

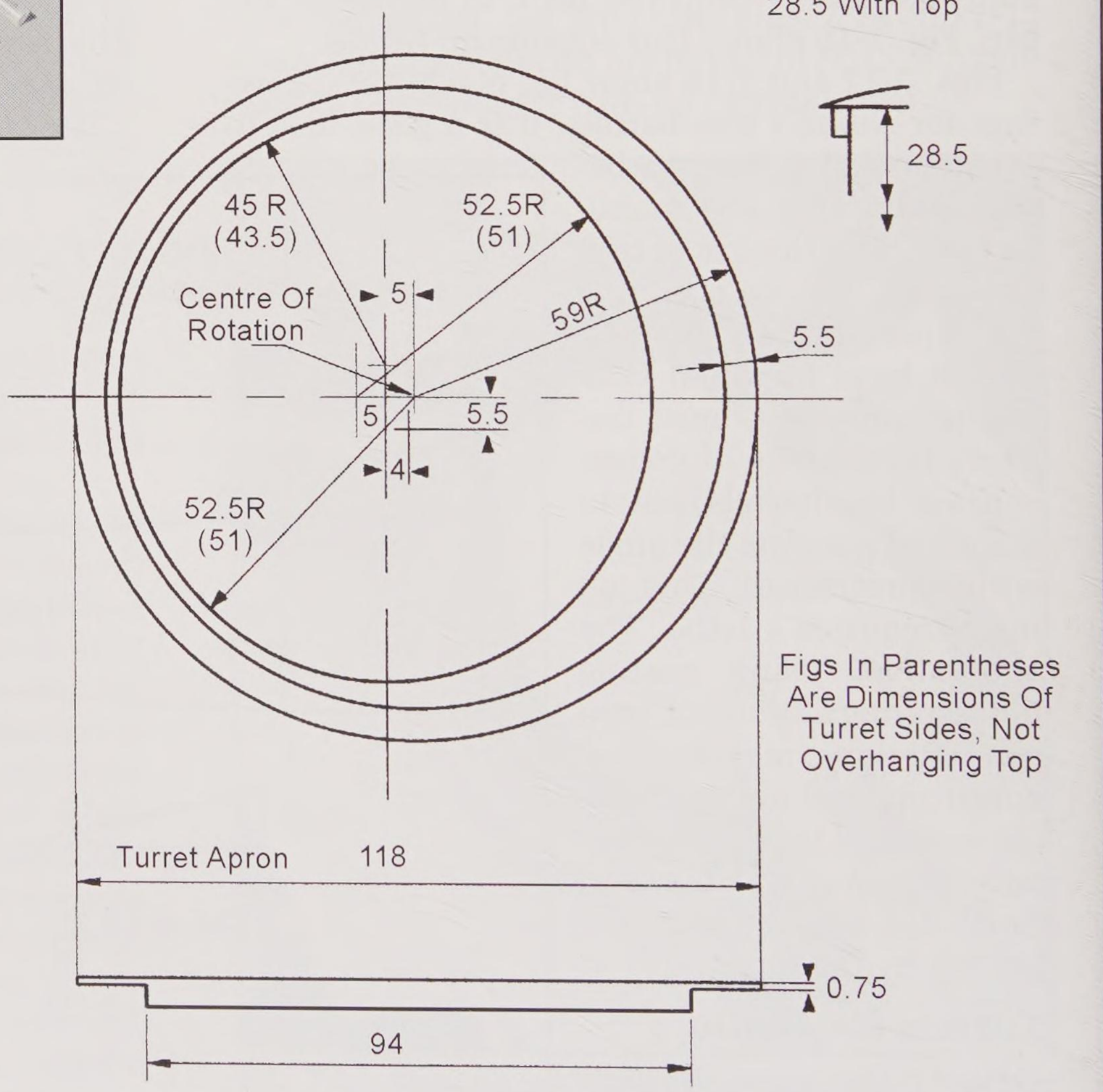
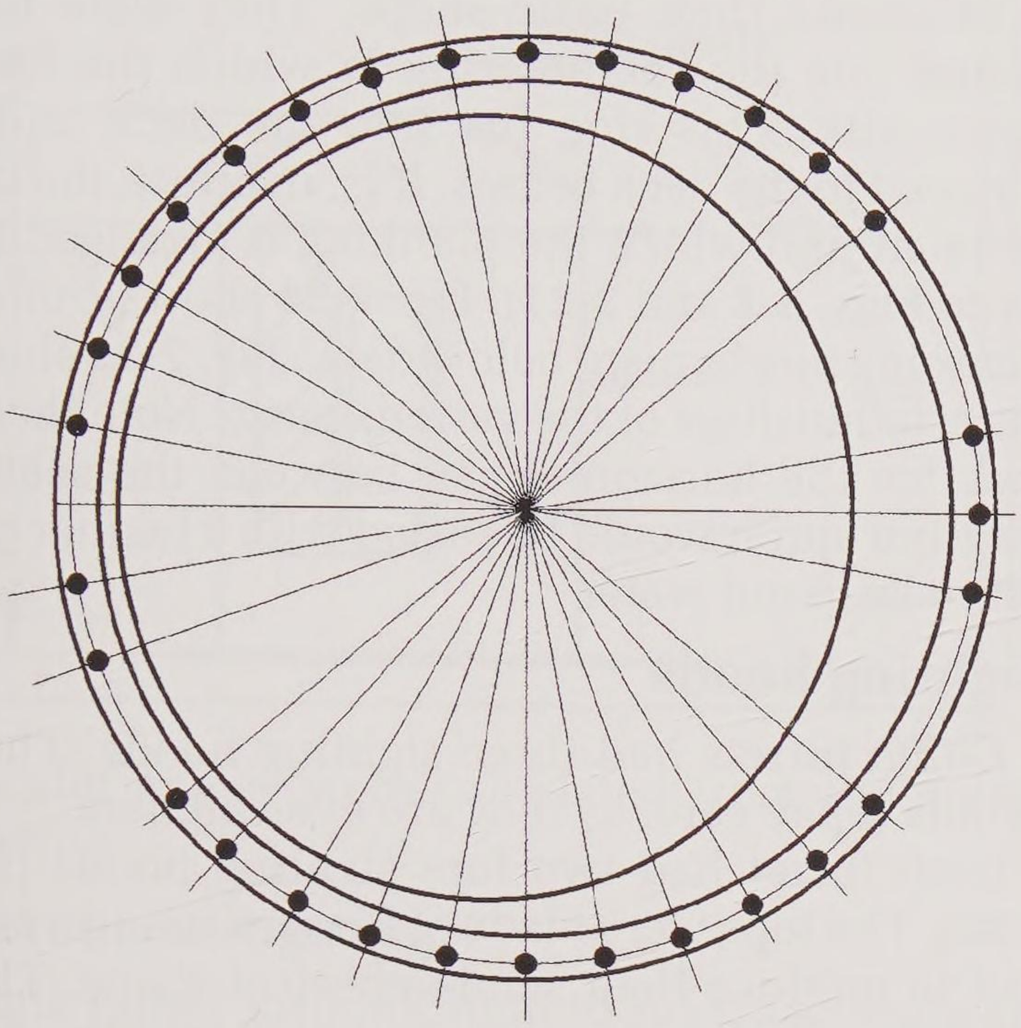


FIG. 21 – BOTTLESCREW BRACKET POSITIONS ON TURRET RING



Turret top

The foundation was 0.02" polycard, which formed the overlapping lip and support for the wood. The carved "dome" part was 3/32" basswood tapering at the edges to the polycard's thickness. Four cutouts for the skylights were made in the wood down to the polycard base. Polycard and wood were assembled with RCS PVA glue, which remains flexible.

It was found advisable to pre-bend the assembly whilst gluing to prevent distortion when the adhesive set. The first unit, glued flat, ended up with its plastic base convex; i.e., the edges turned up. This was the old trouble with an unbalanced sandwich. In this case, it could not be balanced with another layer. By pre-bending slightly in opposition and holding in this position whilst the glue hardened, the drag of the wood was balanced and a flat assembly produced. Lastly, these assemblies were clamped to a flat board to keep them stable until stuck on the turret body. Shaping their non-circular roofs would have been much easier if a lathe could have been used.

It is normal to exhibit turrets with the guns trained fore and aft and slightly elevated. It was decided to model the starboard turret with the muzzles in their loading troughs and the port turret facing aft. The port turret guns had their turret doors shut, so the barrels could be made shorter than the starboard turret's where the open doors permitted a view inside. Consequently, these barrels were mounted on their trunnions in the correct manner. A small flat had to be milled on the turret wall prior to drilling, as the trunnion hole lay at an angle to the turret face. Since no long drill bit was available, the hole had to be bored from both sides, which required careful marking out.

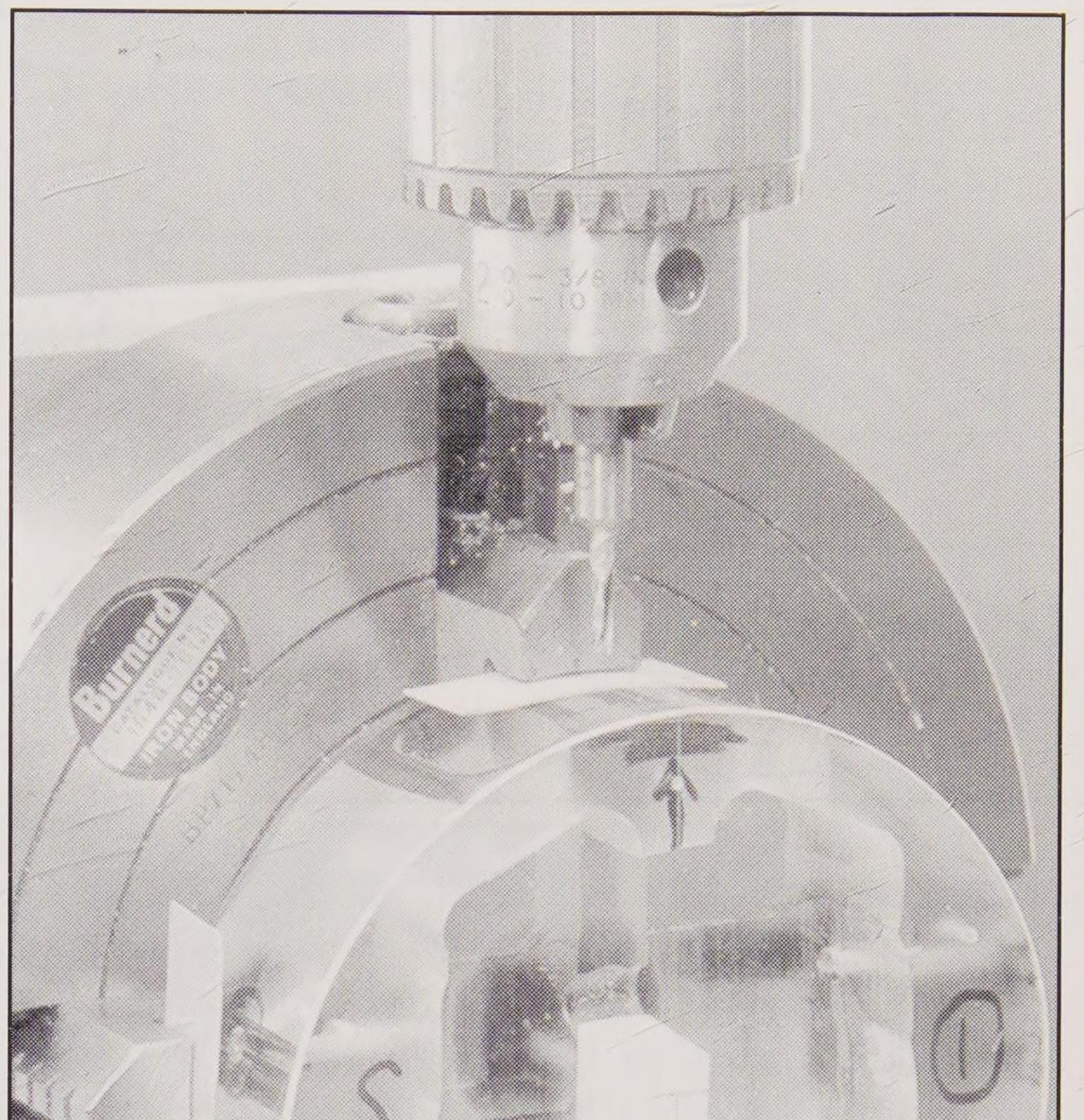


FIG. 7-22. Machining the 3/32" diameter spot faces on the turret sides so the top brackets holding the bottle screws could be seated.

Fig. 7-21 shows the arrangement of the 30 bottle screws. Note that these are radial; i.e., lie normal to the surface, at the rear of the turret. However, this is not so at the sides and on the front. Here the screws lie at an angle to the turret face. Small two-

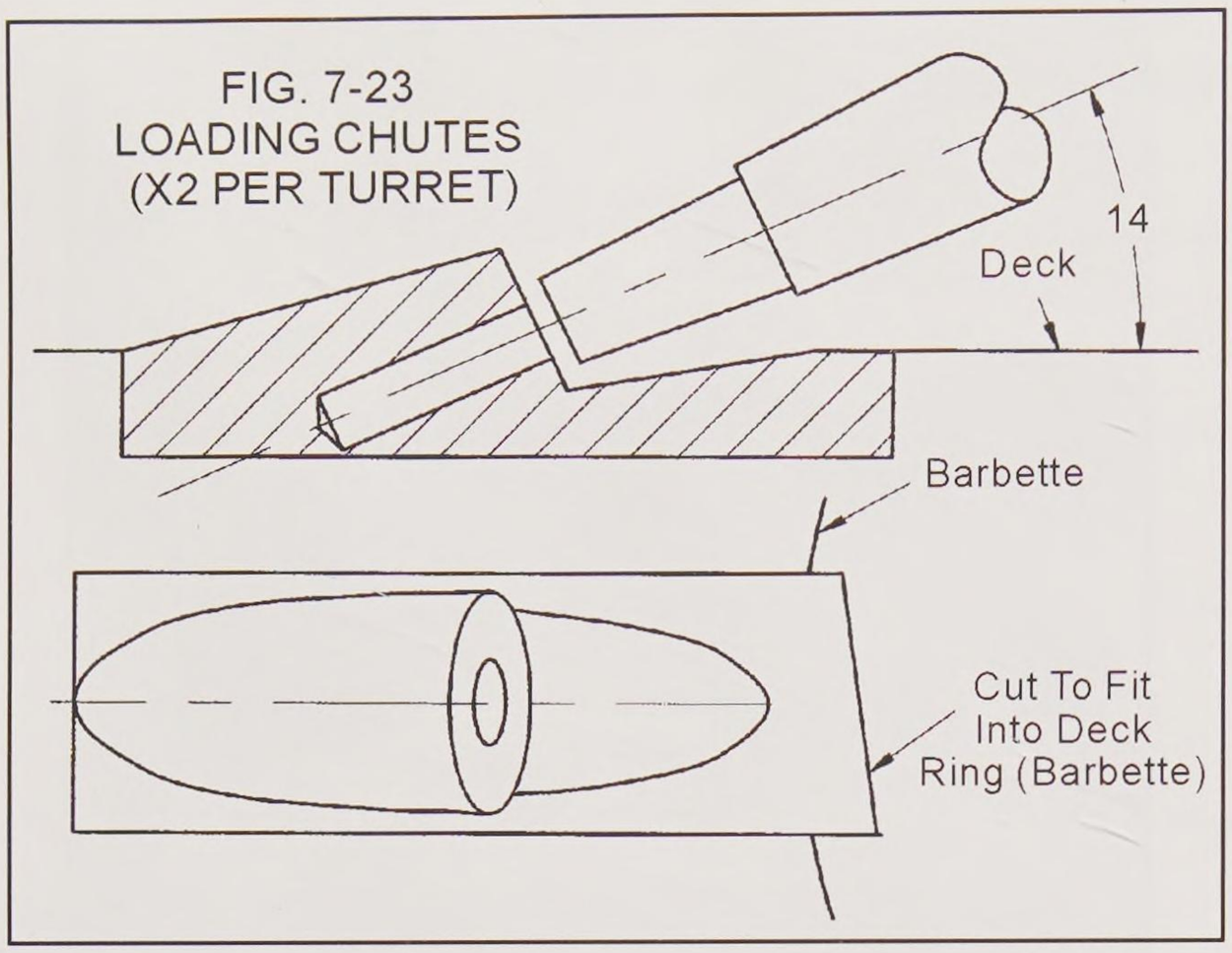


FIG. 7-23
LOADING CHUTES
(X2 PER TURRET)

part brackets soldered together were etched to house both ends of the bottle screws. The top ones on the turret walls were glued into machined recesses. This was done by mounting the chuck on a rotary table on the milling machine (**Fig. 7-22**).

The lower ends of the bottle screws secured into similar brackets on the sealing ring. **Fig. 7-21** was reproduced as a transparency and used for marking out their locations. In case of ignorance, bottle screws are screwed sleeves with a threaded rod in each end. One end has a right-hand thread and the other a left-hand thread. Depending on which way the sleeve is turned, it either lengthens or shortens the assembly. They are used for rigging wherever length adjustment is required.

The loading troughs were made of Perspex. **Fig. 7-23** shows their basic shape. They were integrated into the Perspex ring in which the turret apron sits. This ring fits into the deck and is screwed to the deck beams. It is, in effect, the barbette around which the planking is arranged (refer to **Figs. 3-2** and **3-21**). **Fig. 7-24** shows *Duilio's* ramming mechanism below deck. **Fig. 7-25** shows the relationships of the various parts. Note that in practice the horizontal gap between the sealing ring and apron would be sealed with a leather gasket to keep out water.

Sighting hoods

Duilio turrets had three sighting hoods. These details repay care, as they are eye-catchers.

Each turret had two fore sighting hoods (**Fig. 7-26**). The tops were made of Perspex using a form tool to produce their semi-spherical shape. They were parted off leaving a spigot to fit into the tube of the hood body. The front opening was machined in the body using a slot drill. A piece of tape simulated the shutter; the hinge mechanism at the rear was a brass etching.

Each turret also had one aft sighting hood (**Fig. 7-27**) made entirely of Perspex except for the hinge. Viewing slots were created using a 1mm slot drill in the mill with the work held horizontal in a three-jaw chuck mounted on a rotary table.

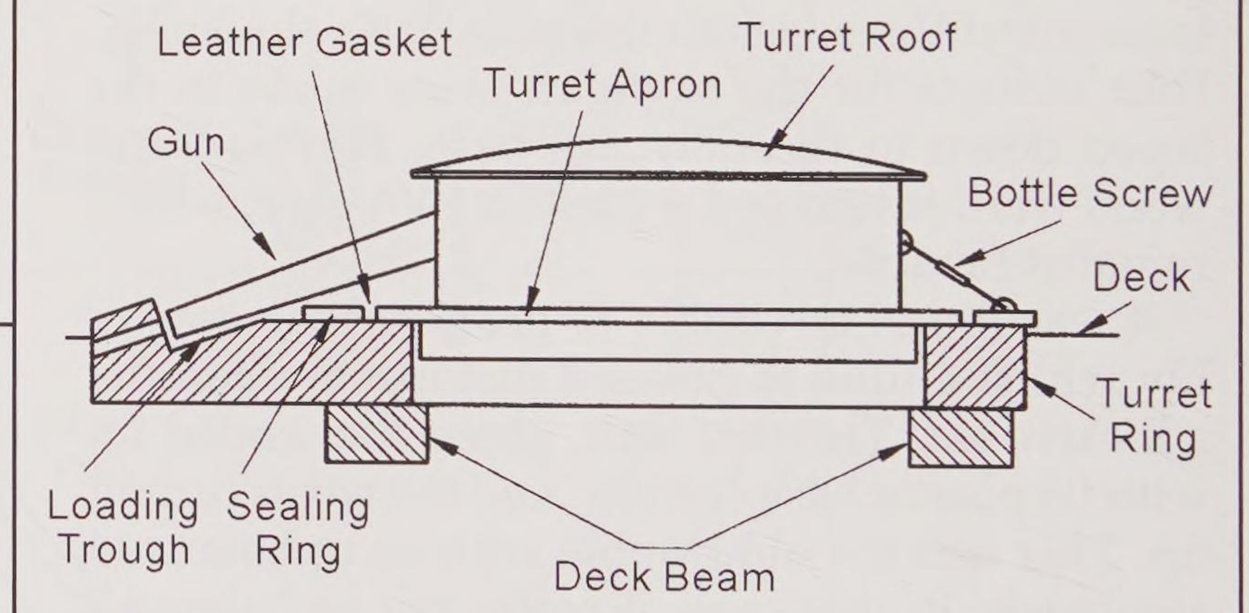


FIG. 7-25 – TURRET ARRANGEMENT

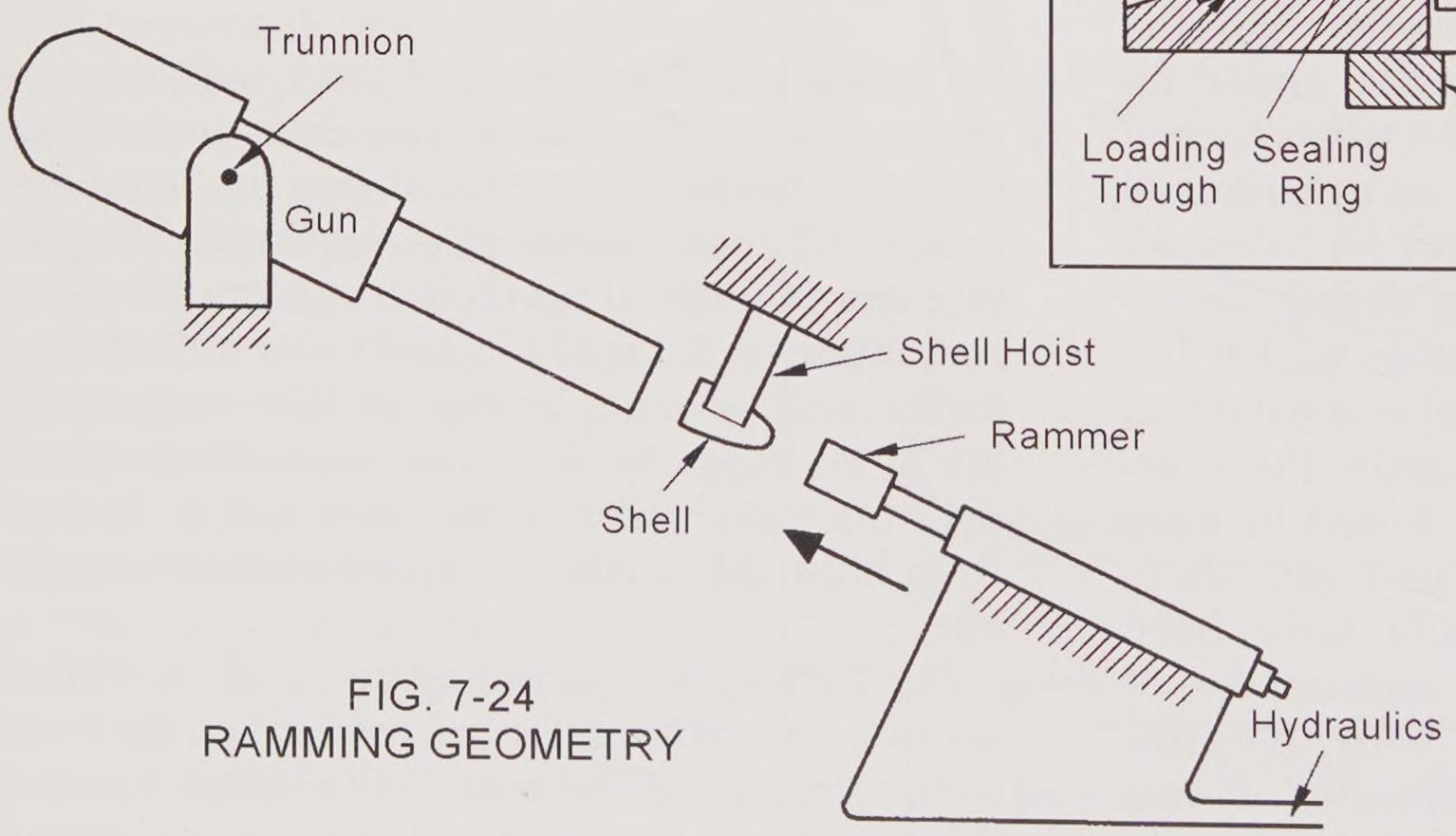


FIG. 7-24
RAMMING GEOMETRY

FIG. 7-26
FORE SIGHTING HOOD (X2 PER TURRET)

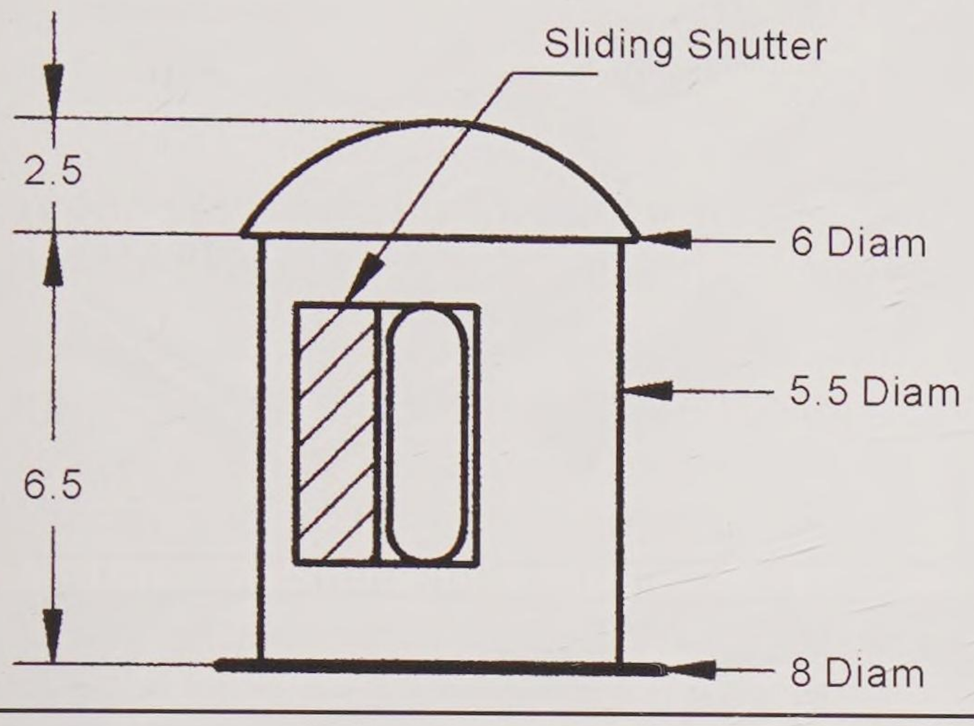
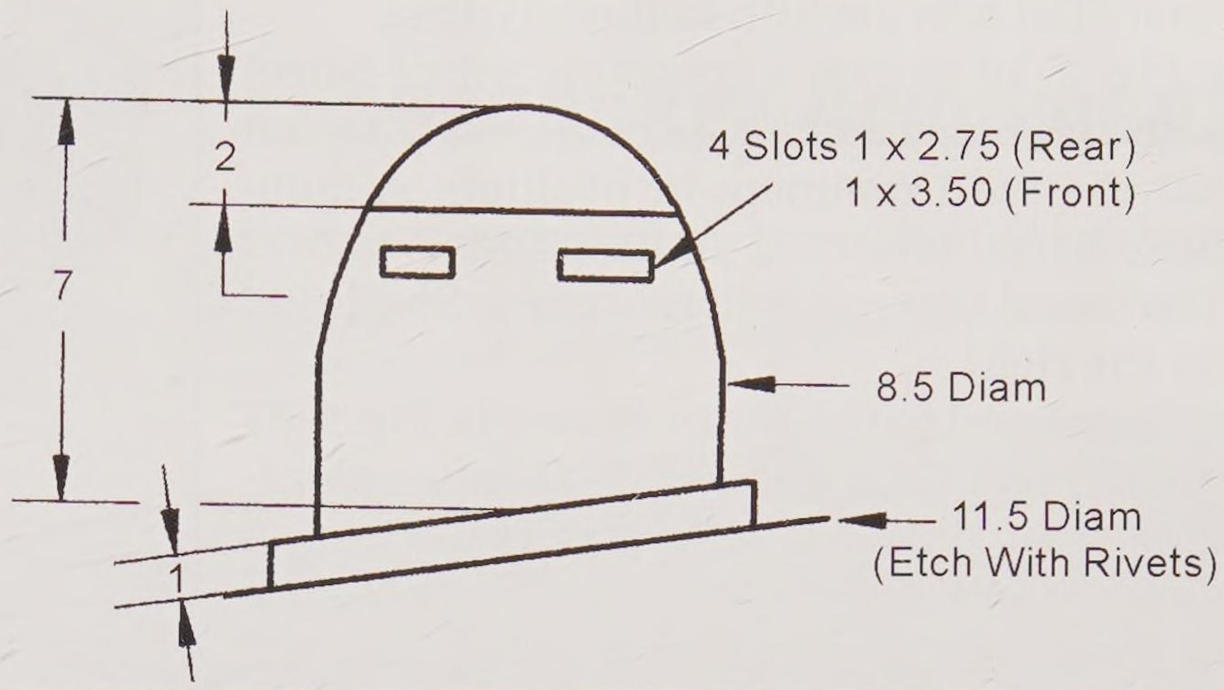


FIG. 7-27 – REAR SIGHTING HOOD (1 PER TURRET)



The slot angles were calculated from the detail drawing.

Turret sealing ring

This rather difficult item to manufacture warrants a comlete piece on its machining. Its outside diameter was 117.5mm and the internal diameter 106mm and 1.6mm thick. I made two of these from 1/16" polycard, one for each turret. They had to be accurate to size and cleanly machined. It was decided to trepan them on the lathe. This operation makes even tough tool room turners blanch, but faint heart never won fair lady or made pristine turret sealing rings.

A square of material large enough to cover the outside diameter was screwed to a wood faced faceplate on the lathe (**Fig. 7-28**). Inner and outer circles were marked absolutely concentric with the centre of rotation. The centre was then machined out using a side cutting boring tool. The first cut was well inside the line (smaller diameter) and taken through into the wood. With the centre removed, the inside edge was carefully machined to the line, making sure the whole edge was in contact with the tool's cutting edge to produce a clean cut. The problem with trepanning is that the tool does not break through cleanly all round at the same moment and, consequently, the centre piece can tear out and ruin the job.

Next, a plywood disc slightly smaller than the ring's outside diameter was screwed to the wood backing to adequately clamp the ring (**Fig. 7-29**). The turning process was repeated, first penetrating outside the wanted diameter, then carefully

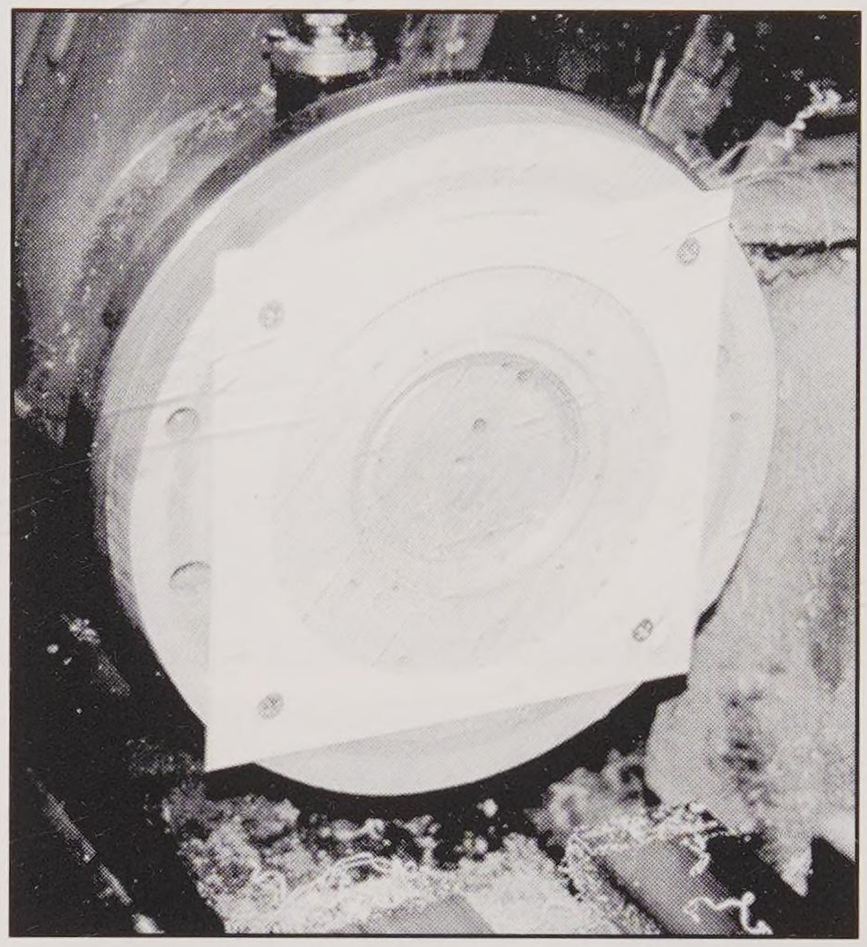
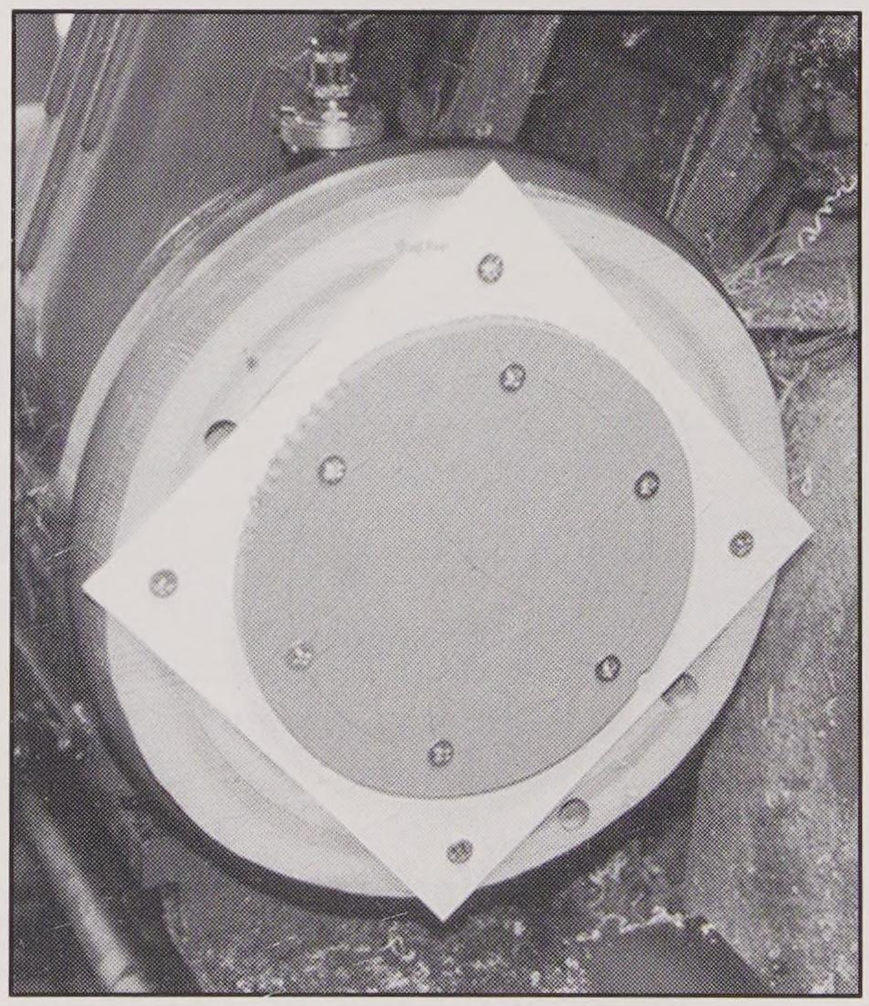


FIG. 7-28: Trepanning the sealing ring's internal diameter.



(Below) FIG-7-29: Clamping the sealing ring before machining its outside diameter.

cleaning up to the line. Incidentally, the face of the wood backing was turned absolutely flat and smooth before starting.

Fig. 7-30 shows a complete set of turret parts for *Magnificent.* The barbette on the left has the twin rammers in position. A complete barrel mounted on its cradle is above. The barrel was made in two parts. Shells are on the right.

Turret and barbette are shown in **Fig. 7-31** (before painting) and **Fig. 7-32** (after painting). The finished aft turret is shown in position in **Fig. 7-33** (c/s), and **Fig. 7-34** is a closeup view of the internal detail.

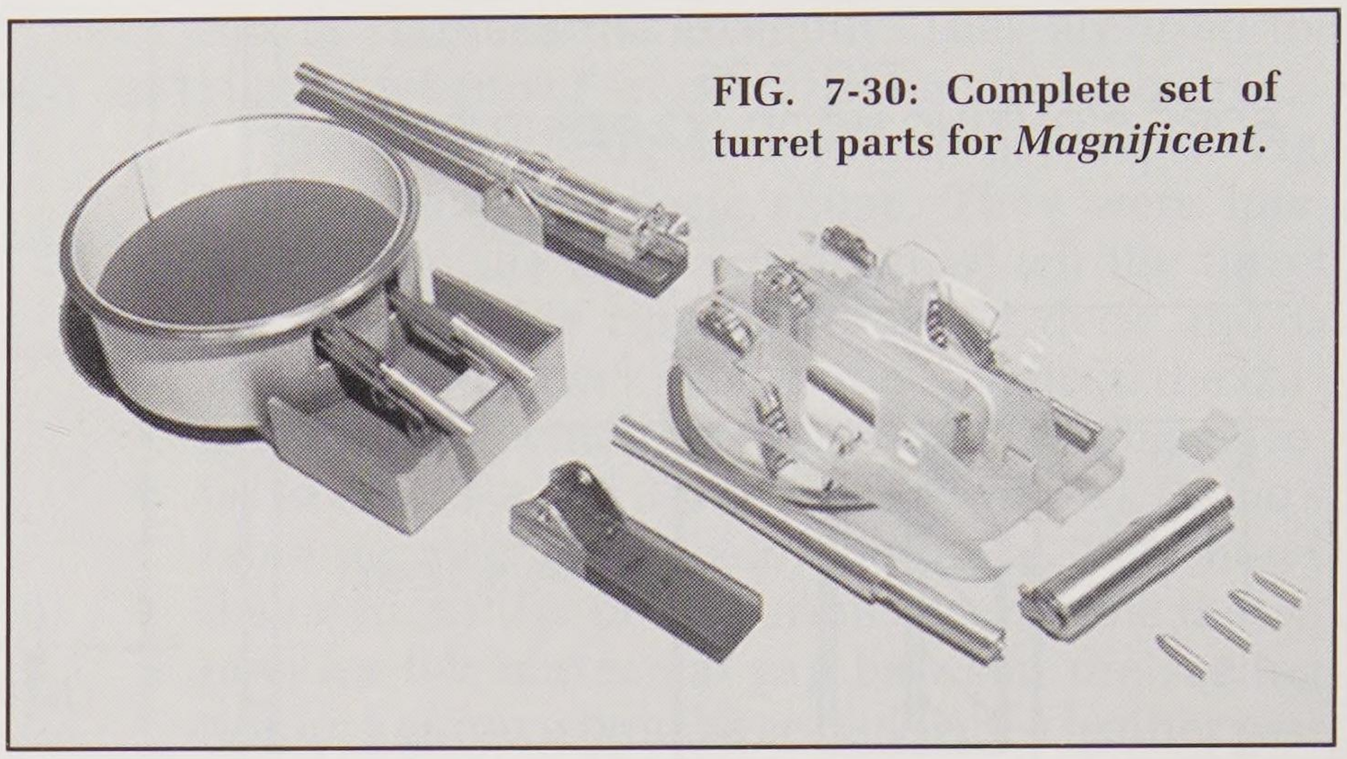


FIG. 7-30: Complete set of turret parts for *Magnificent*.

FIG. 7-31: *Magnificent's* turret and barbette before painting.

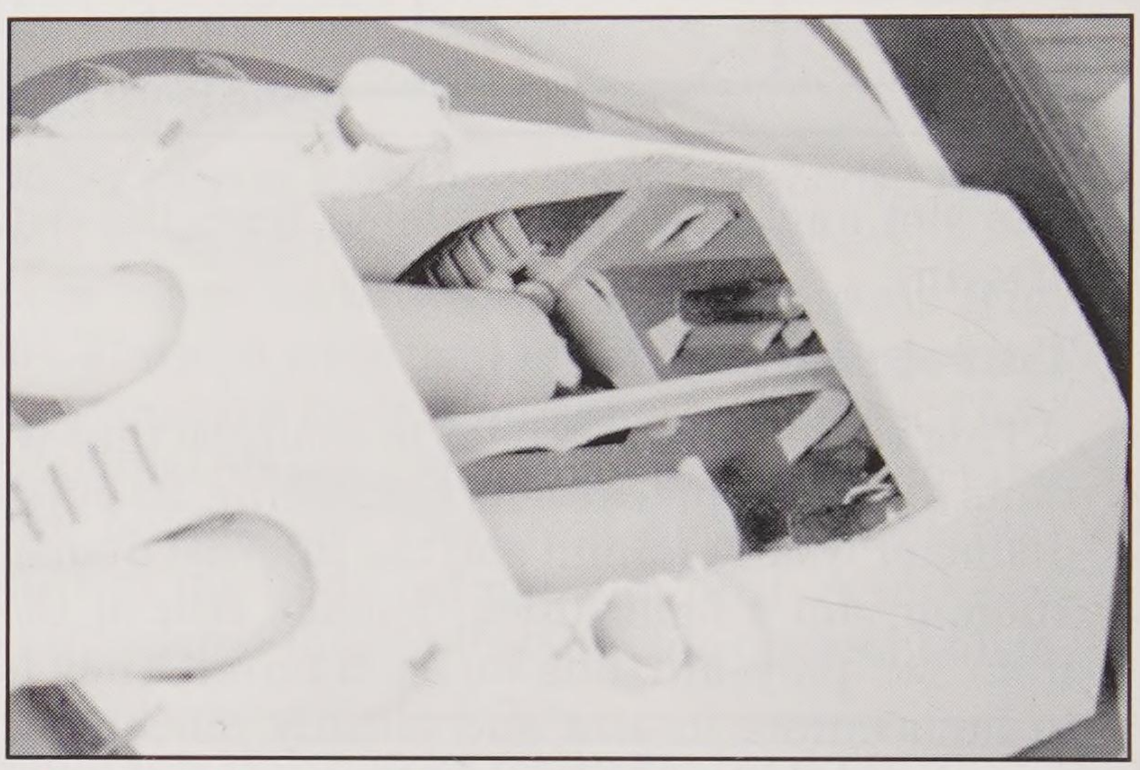


FIG. 7-34: Closeup of *Magnificent's* aft turret interior .

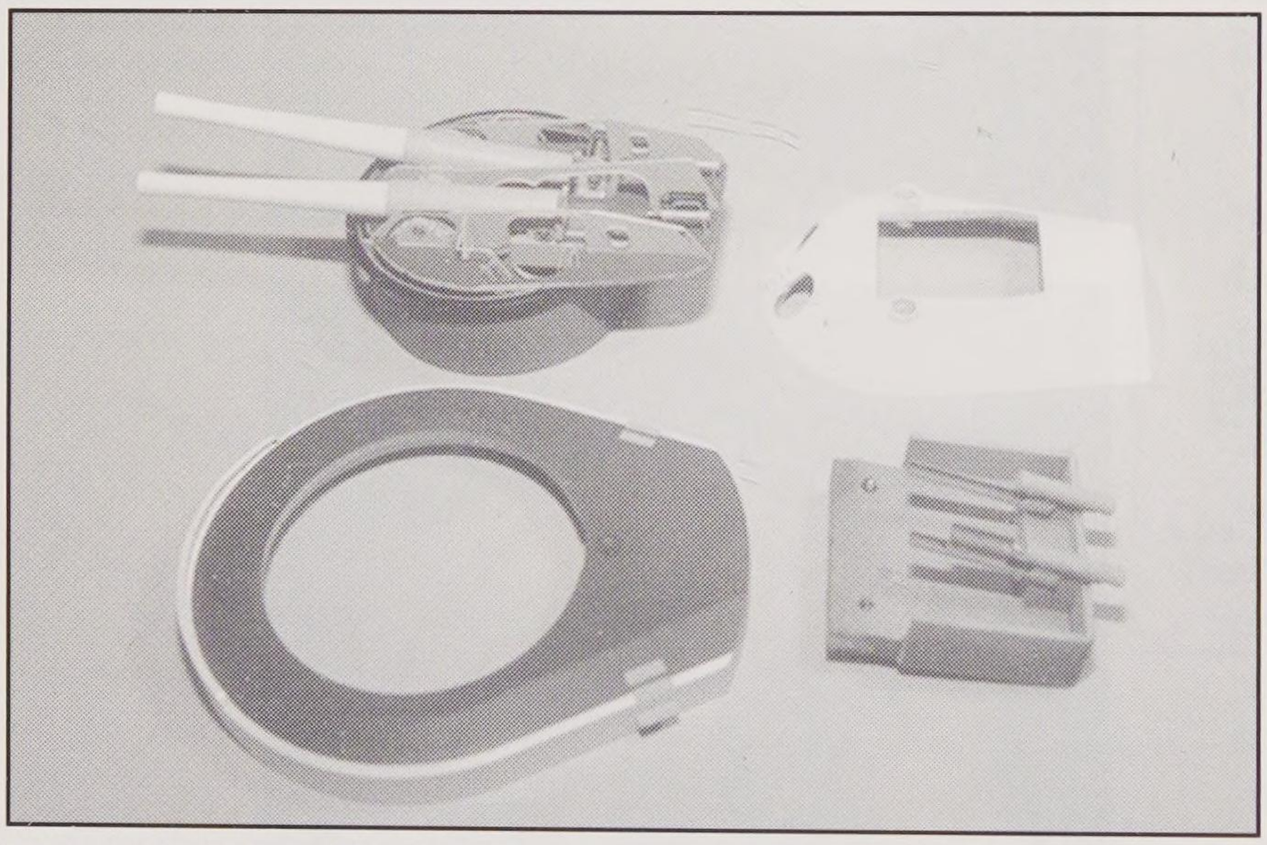
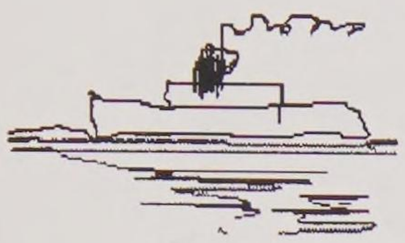


FIG. 7-32: Painted turret pieces.



Chapter Eight

Secondary Armament

Larger secondary armament breech-loading guns

Single-barrelled guns firing "fixed" ammunition were developed and enlarged to 4.7" and even 6" calibre by Armstrong in England and Krupp in Germany. Fixed ammunition (shell and cartridge in one) eliminated cleaning smouldering debris from the bore and increased firing rates. However, there was a limit to the size of the ammunition a crew could handle. The French Schneider 15cm (6") needed three men to load each round. Not a very likely arrangement for producing the highest rates of fire.

Guns this large (4.7" to 6") had outgrown their former role as an anti-torpedo boat weapon and could be used on the unarmoured areas of larger ships.

Most larger guns present little trouble to the modeler, as they are usually casemated (*casemate*: protected or armoured position for a gun battery) and only the barrel is visible (**Fig. 8-1**). As can be imagined, opening such a position with any kind of sea running would be out of the question. **Fig. 8-2** shows *Empress of India's* complicated semi-conical casemate below the main deck. **Fig. 8-3** shows the master mould and a finished, unpainted casemate with thin roof added.

HMS Victoria's battery deck (**Fig. 8-4**) has 6" breech-loading guns (six each side) and is completely detailed, as I did not know how much would be visible through the gunports and companionways. In the event, nothing was visible through the ports and precious little around the companionways! A great deal of unnecessary work, but if anybody in the future shoves an endoscope in there, he or she should have a pleasant surprise! *Victoria's* secondary armament arrangement is reminiscent of the gun deck on a Trafalgar-era ship (**Fig. 8-5** c/s).

However, if a mounting is visible and requires detailing, you will have to find information for that particular mark of gun and mounting. **Fig. 8-6**

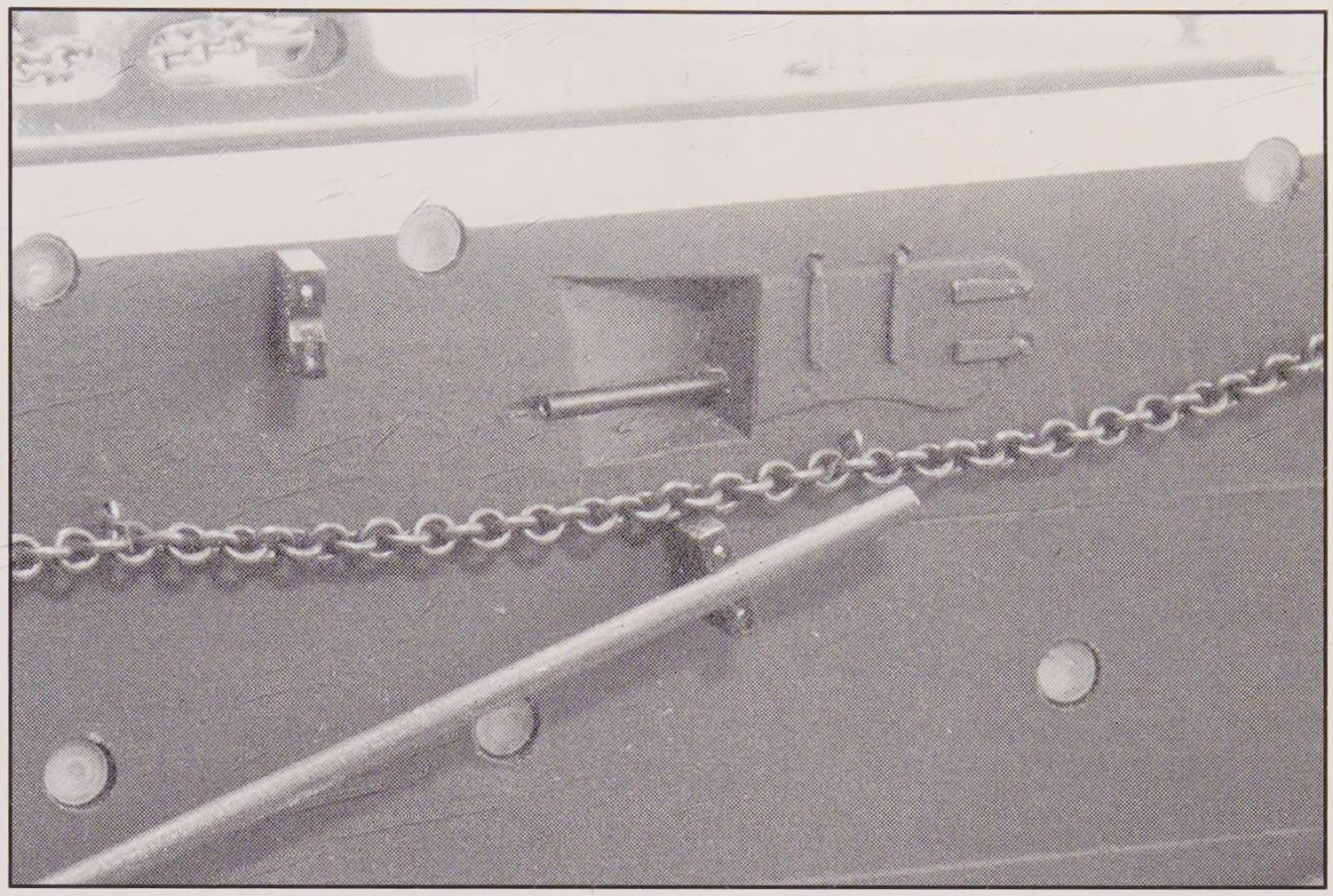


FIG. 8-1: *Empress of India* hull.

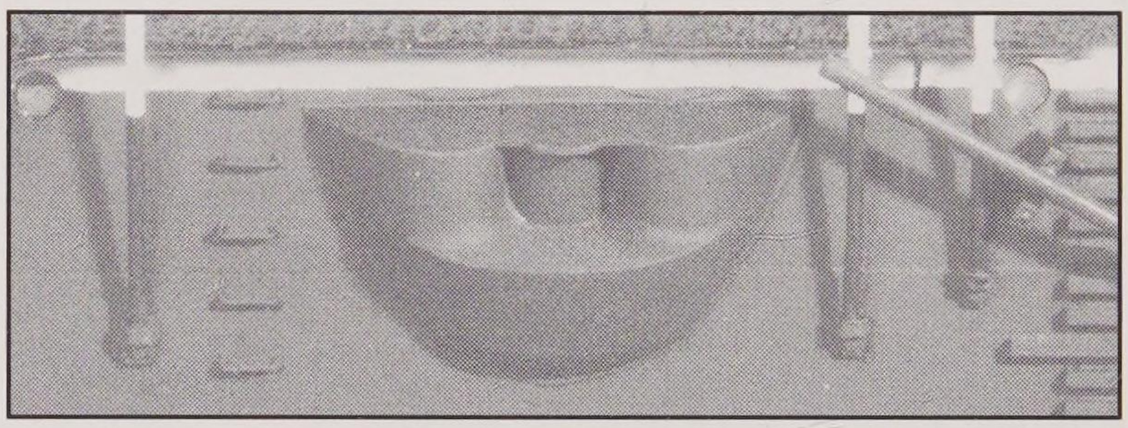


FIG. 8-2: Conical casemate in *Empress of India's* hull.

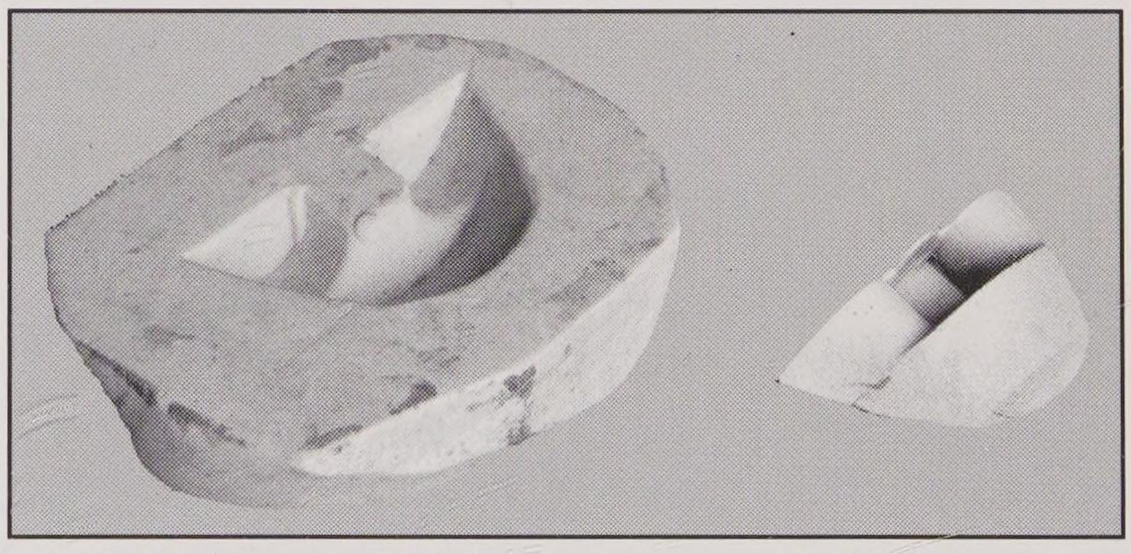


FIG. 8-3: *Empress of India's* casemate and mould.

shows a 6" turreted gun on *Empress of India*. Notice that the top half of the bulwarks on the gun position are hinged down and almost touching the rolled up anti-torpedo net.

Duilio carried two types of cannon that were

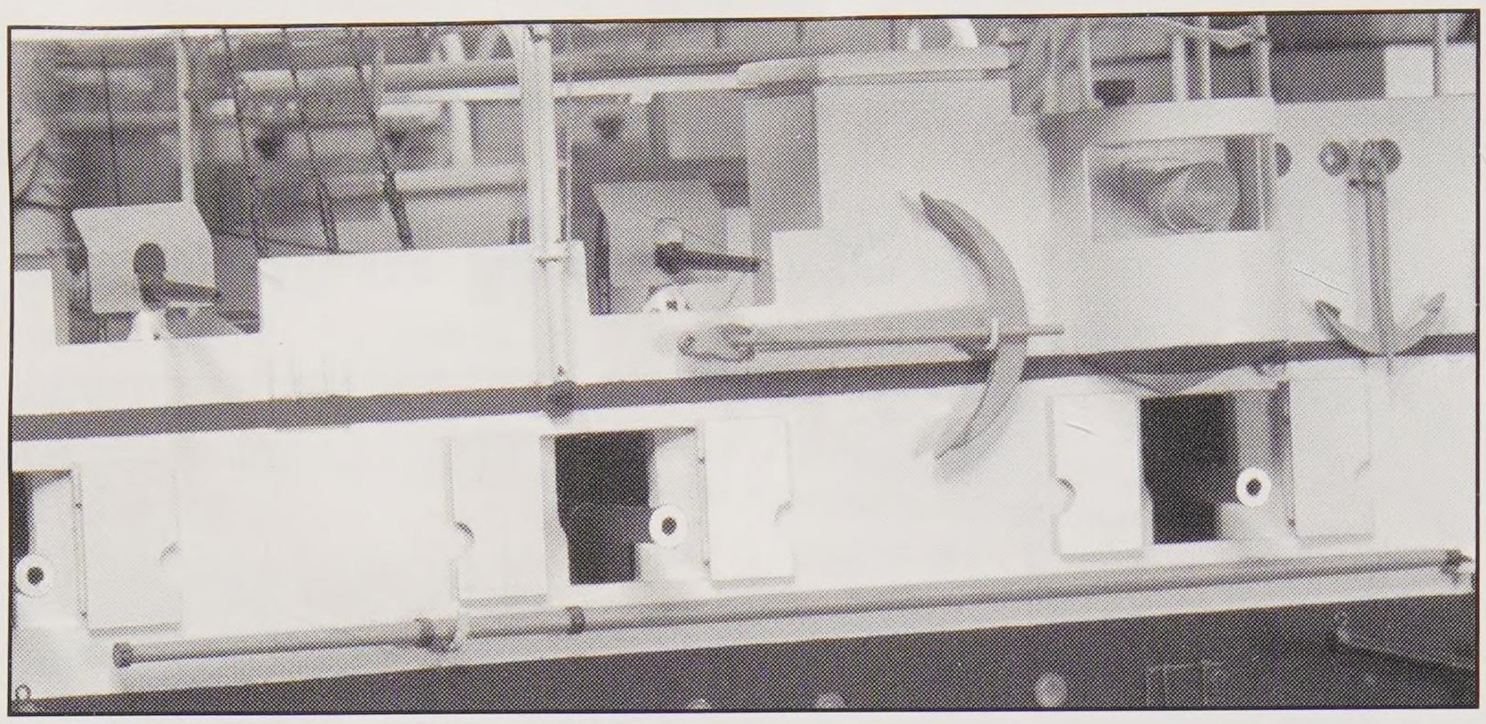


FIG. 8-4: *Victoria's* 6" breech-loaders.

unknown to the writer (**Figs. 8-7** and **8-8**). **Fig. 8-9** shows the etched and turned parts for the cannon in **Fig. 8-8**, including the mounting ring. The etched parts have not yet been cleaned up.

Quick firers

Smaller weapons were 3-, 6-, and 12-pounder quick-firing guns mostly for anti-torpedo de-

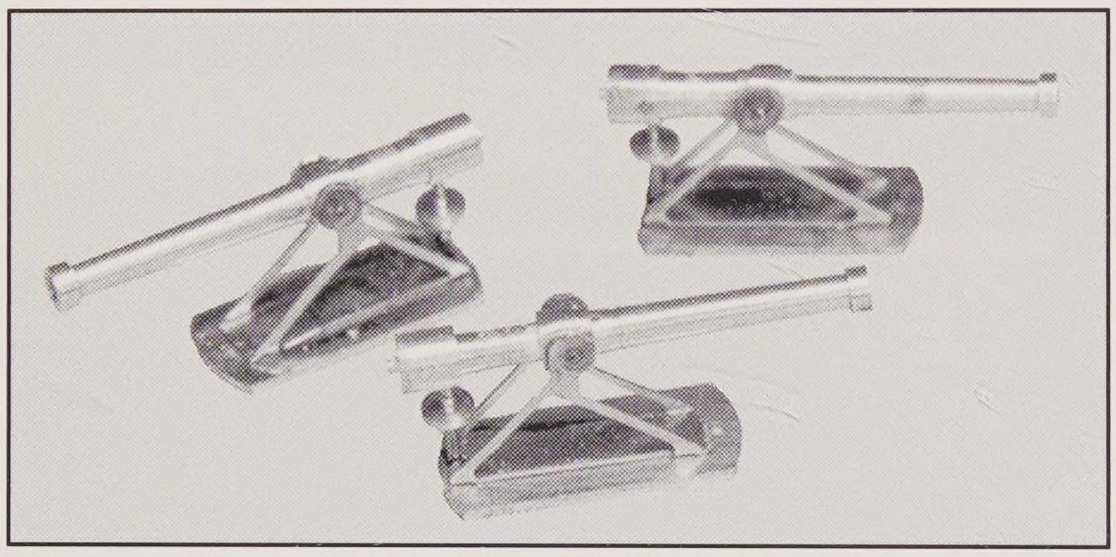


FIG. 8-8: Unpainted cannon for *Duilio*.

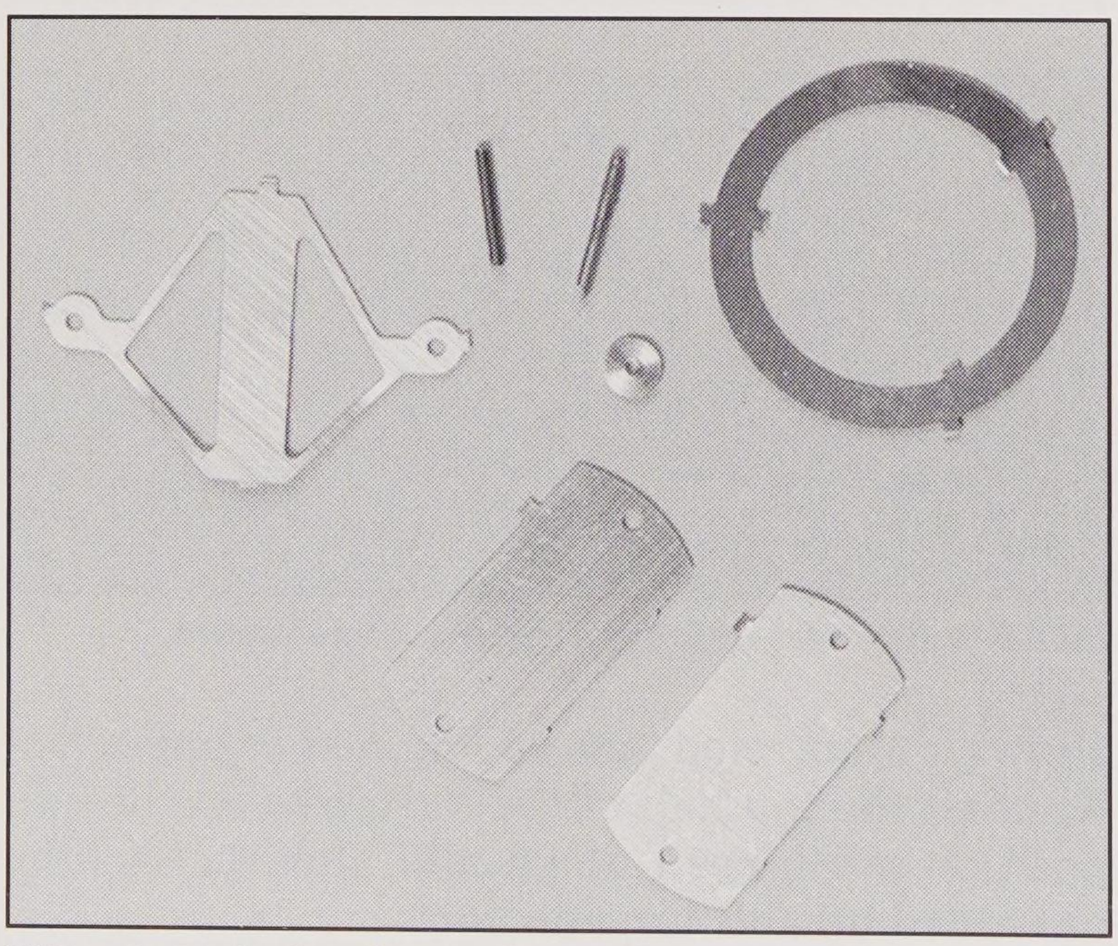
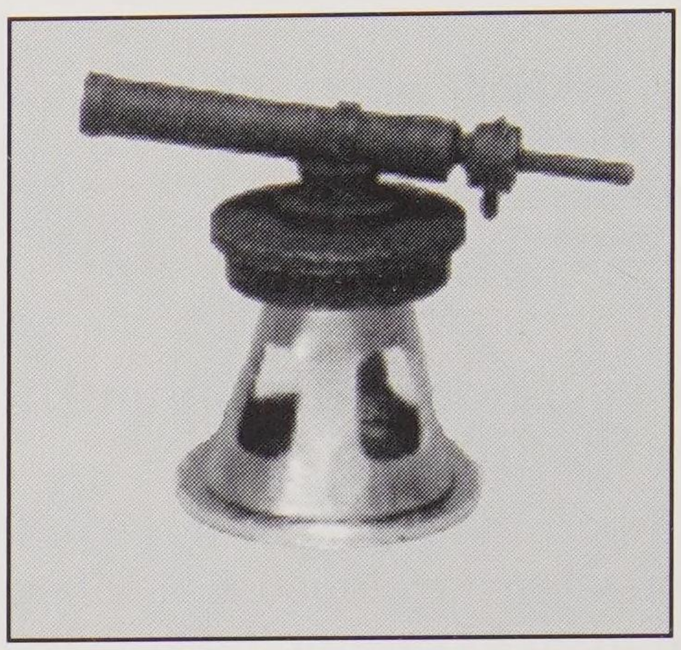


FIG. 8-9: Etched and turned parts for cannon in Figure 8-8.



FIG; 8-7: Cannon for *Duilio*.

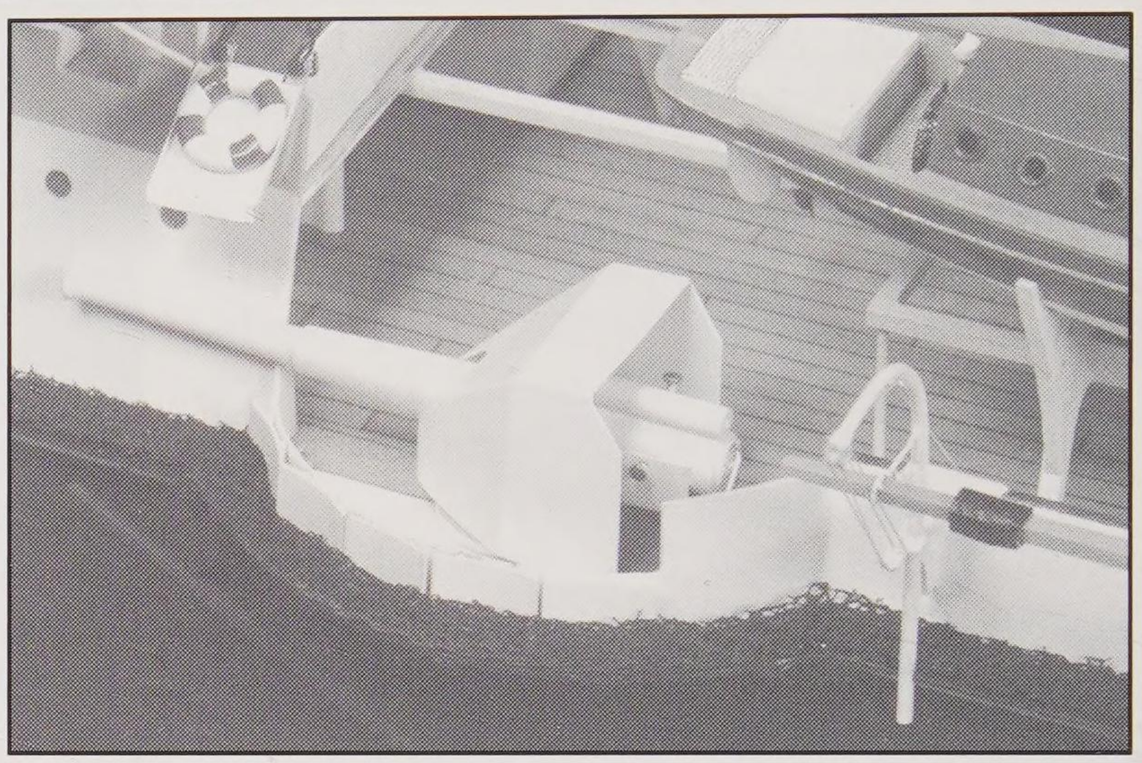
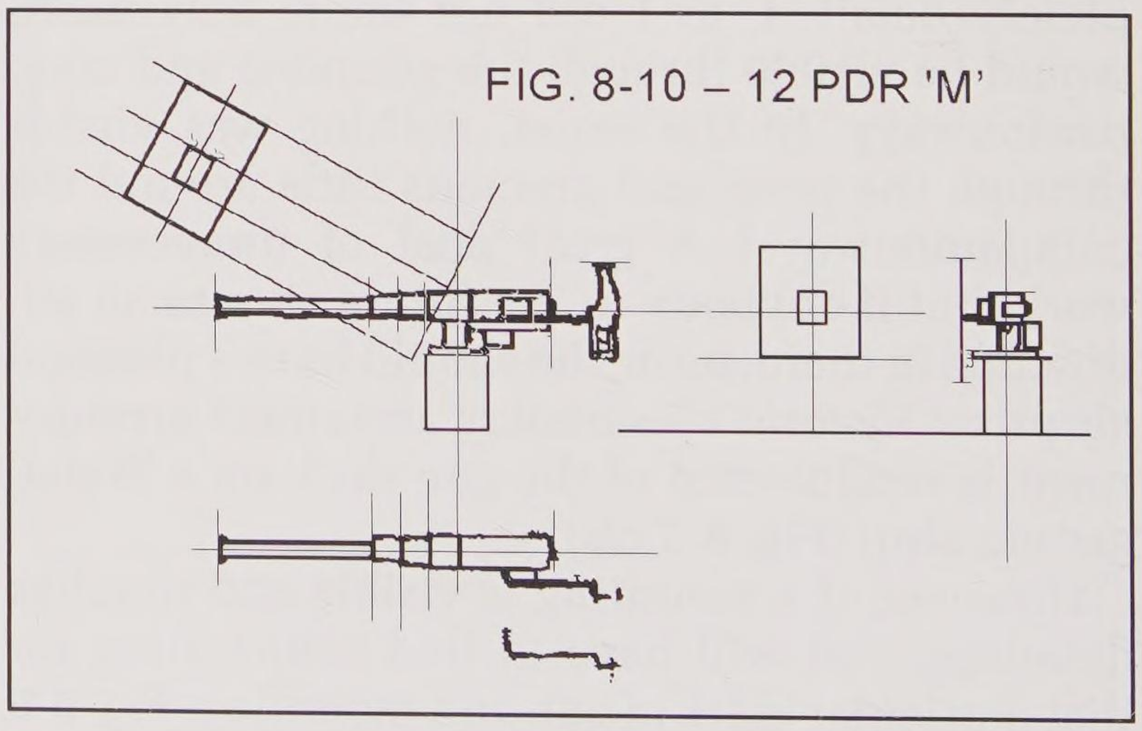


FIG. 8-6: Six-inch turret gun on *Empress of India*.

fence. **Fig. 8-10** shows a 12-pounder quick firer. **Fig. 8-11** shows a quick firer along side a Nordenfeld machine gun. On the main deck is a 7-pound cannon on a field mounting for land use. A great scare occurred about this time with the successful and promising Whitehead torpedo, and everyone was busily building very fast torpedo boats. The scare was probably exaggerated, but until the battle of Tsushina during the Russo-Japanese war (1904), no practical experience was available. (At



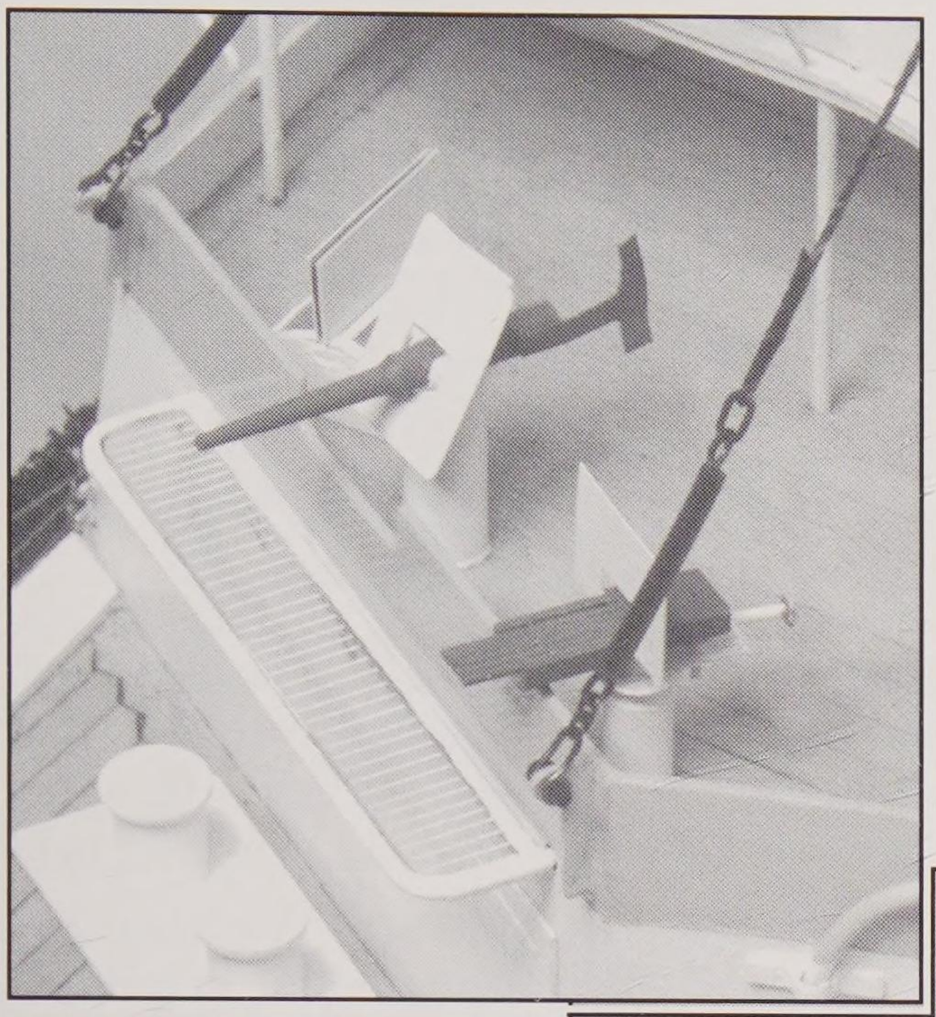


FIG. 8-11 (left): Quick-firer on *Empress of India*. FIG. 8-12 (above): *Magnificent's* collection of quick-firers and land guns.

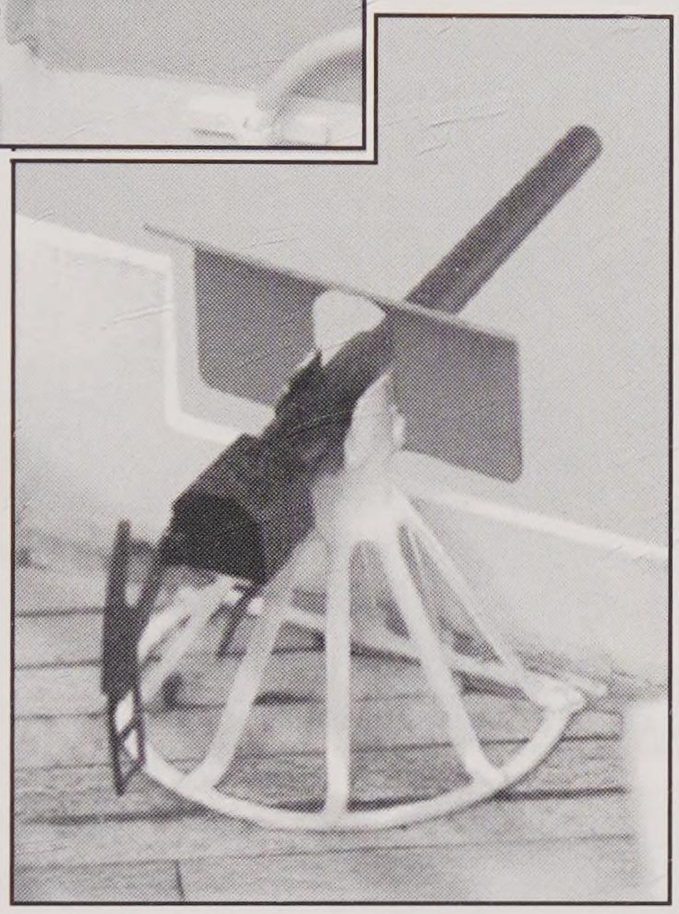


FIG. 8-16: Gun mount.

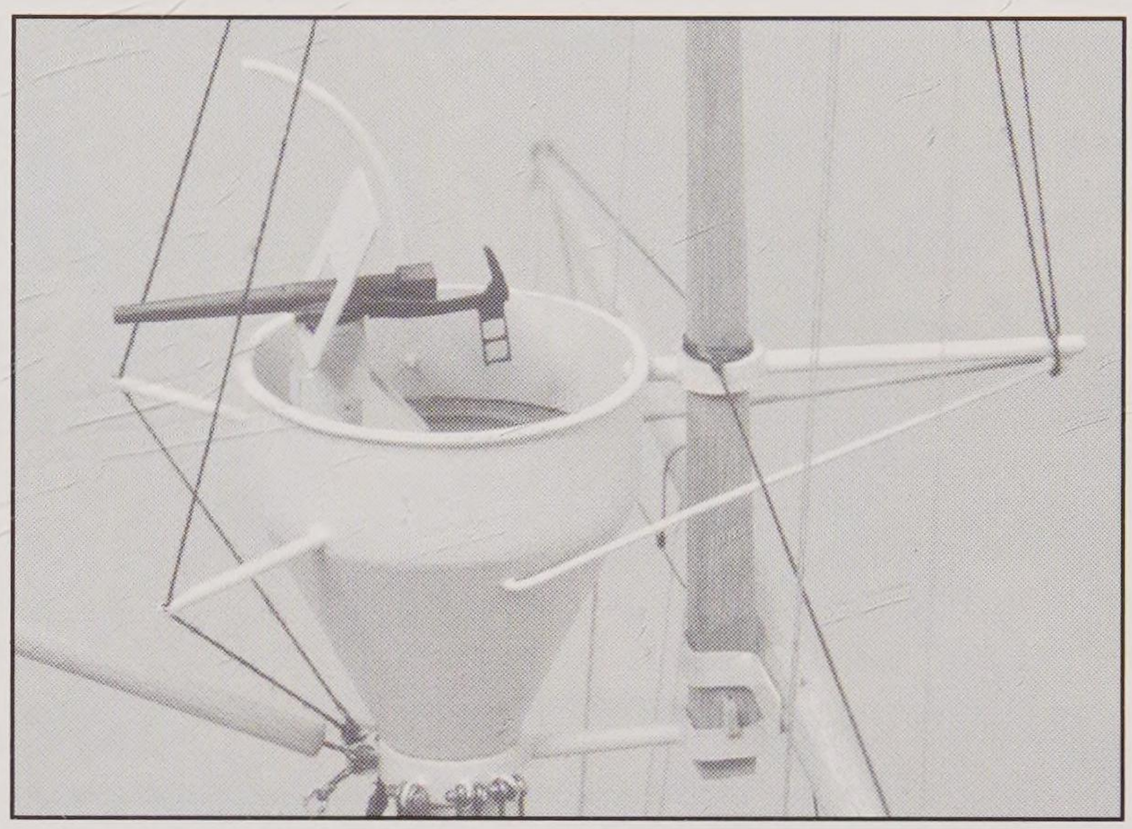
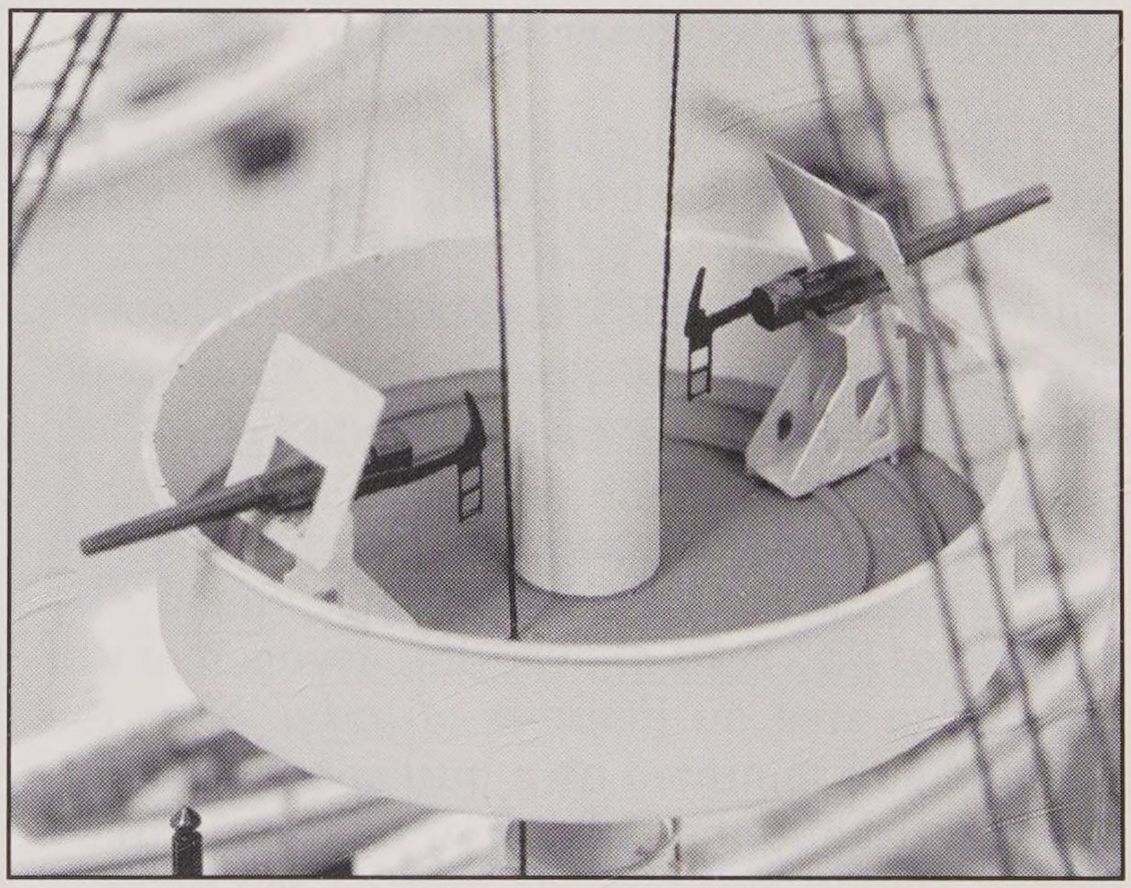


FIG. 8-13 (above): Quick-firer in *Victoria's* upper fighting top and, below, in her lower fighting top (Fig. 8-15).



the start of the battle, torpedoes did not give the expected results.) **Fig. 8-12** shows some of *Magnificent's* unpainted weaponry. The top row are the quick firers for the fighting tops and the lower guns are heavier weapons. It also shows a 7-pounder mounted on a field carriage with its associated limbers. Victorian battleships carried this equipment for land use, often performed while executing the Pax Britannica – chasing slave traders and the like.

All these quick-firers were shoulder guided. They had an arcuate rubber-covered shoulder pad with the "ladder" hanging down to act as a grip for the gunner's left hand (**Fig. 8-13**). One wonders why three sizes were necessary: if the three-pounder was large enough, why have larger weapons, and if it was not, why have it all? One presumes a light gun was necessary for fighting tops, as weight was a problem at that height. **Fig. 8-14** (c/s) shows three quick firers in *Magnificent's* fighting top and a searchlight platform just above. Also note the starfish immediately underneath the searchlight platform which supports the upper mast's rigging.

These three weapons are basically similar in construction except their mounts were tailored to their position. Guns in fighting tops, and they usually had two or three, were mounted on circu-

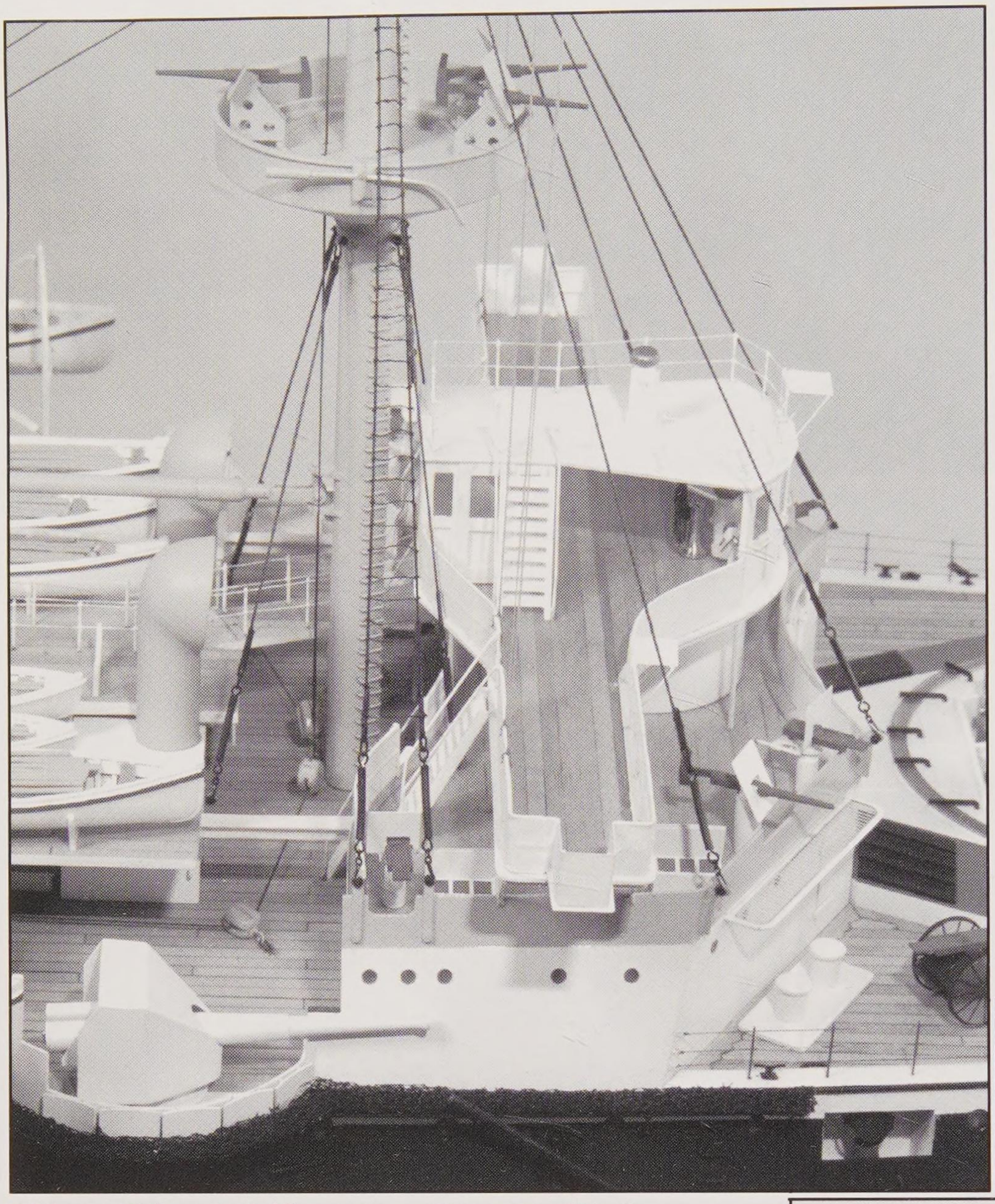


FIG. 8-19 (above): Bridge area on *Empress of India*.

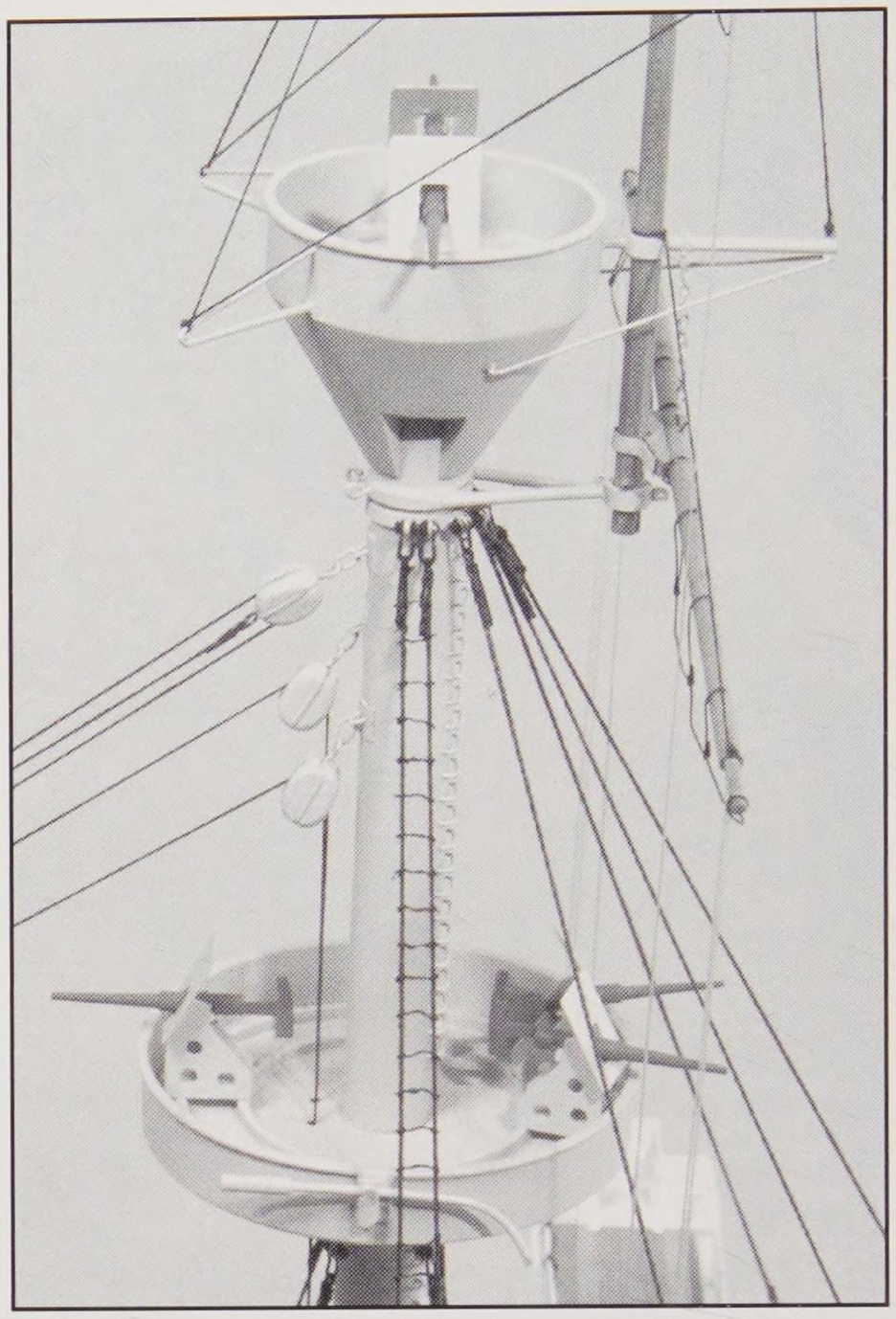


FIG. 8-17: Guns in *Empress of India's* fighting top.

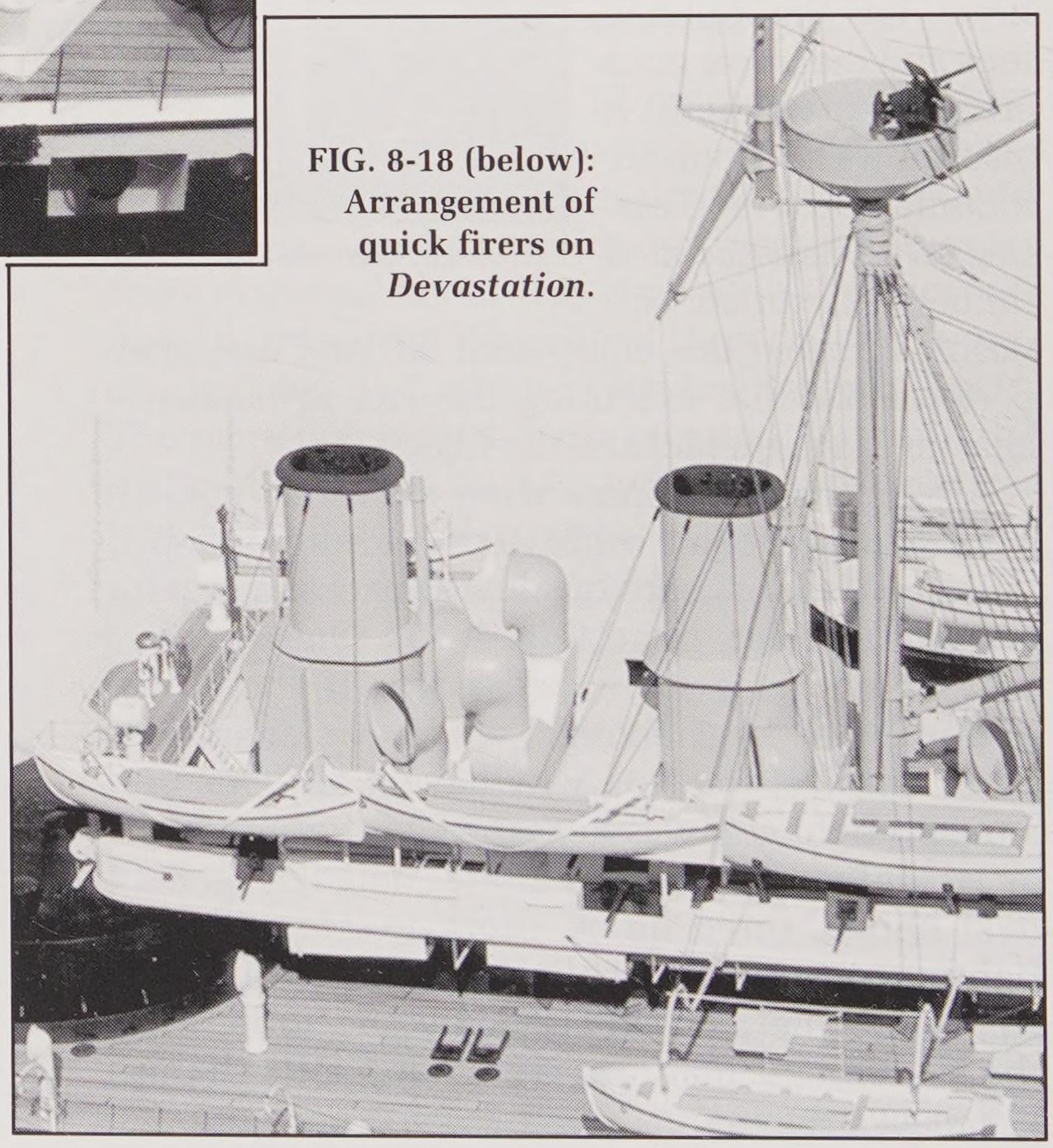


FIG. 8-18 (below): Arrangement of quick firers on *Devastation*.

lar rails for easy movement (**Fig. 8-15**). Others were fixed to the deck on conical mounts made of strips (**Fig. 8-16**). Certainly the shoulder rest, ladder, shield (if fitted), and most of the mount are ideal etching exercises. **Fig. 8-17** shows typical weapons of this type in *Empress of India's* fighting tops.

Fig. 8-18 shows *Devastation's* arrangement of quick firers in the fighting top and flying deck's bulwarks. **Fig. 8-19** shows the arrangement of the bridge area on *Empress of India*. Note the turreted gun mounted on a hull sponson pointing forward and the quick firer on the auxiliary bridge. Coiled anti-torpedo netting can be seen around the gun position. The bulwark's hinged part is in the lowered position.

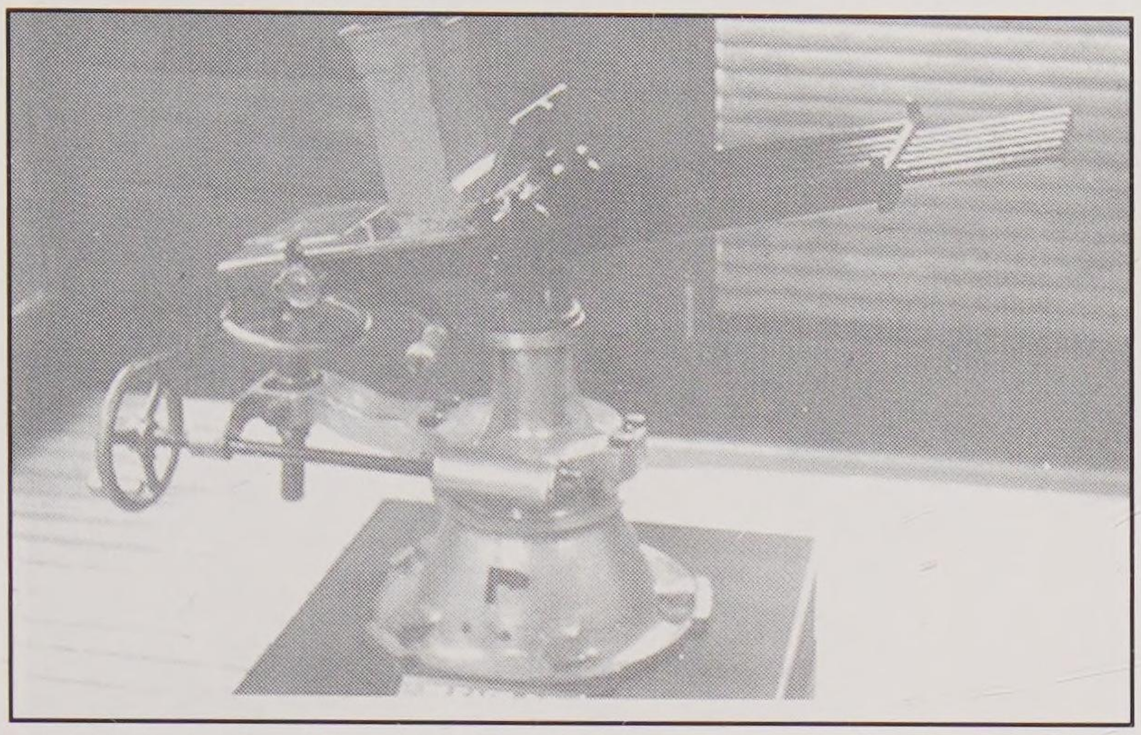


FIG. 8-20: Gardiner/Nordenfeld machine gun at the National Maritime Museum in Greenwich, London.

Machine guns

A number of types were available at this time. The Royal Navy tended to fit Gardiners and Nordenfelds (**Fig. 8-20**). Both were multi-barrelled with two to five barrels arranged side by side. They were fed from an upright hopper and operated by a horizontal firing lever on the right-hand side. Moving the lever to and fro charged, fired, and extracted the cartridges. Because this action upset the aim of a shoulder-guided weapon, elevation and training were controlled by screws that the number aiming the weapon manipulated. Firing was not continuous, but consisted of "ripples" of shots. **Fig. 8-21** shows two machine guns mounted on *Victoria's* bridge.

The Gatling gun was also available but not fitted, as far as I know,

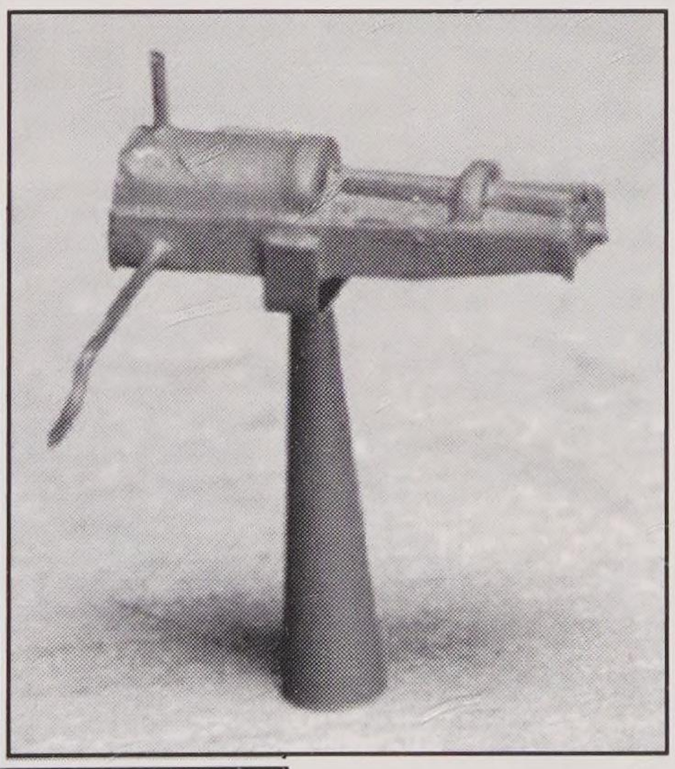


FIG. 8-24 (above): Field carriage and limber on *Magnificent*. Fig. 8-22 (inset): *Duilio's* 3.7cm Hotchkiss revolverkanone (Gatling-type gun).

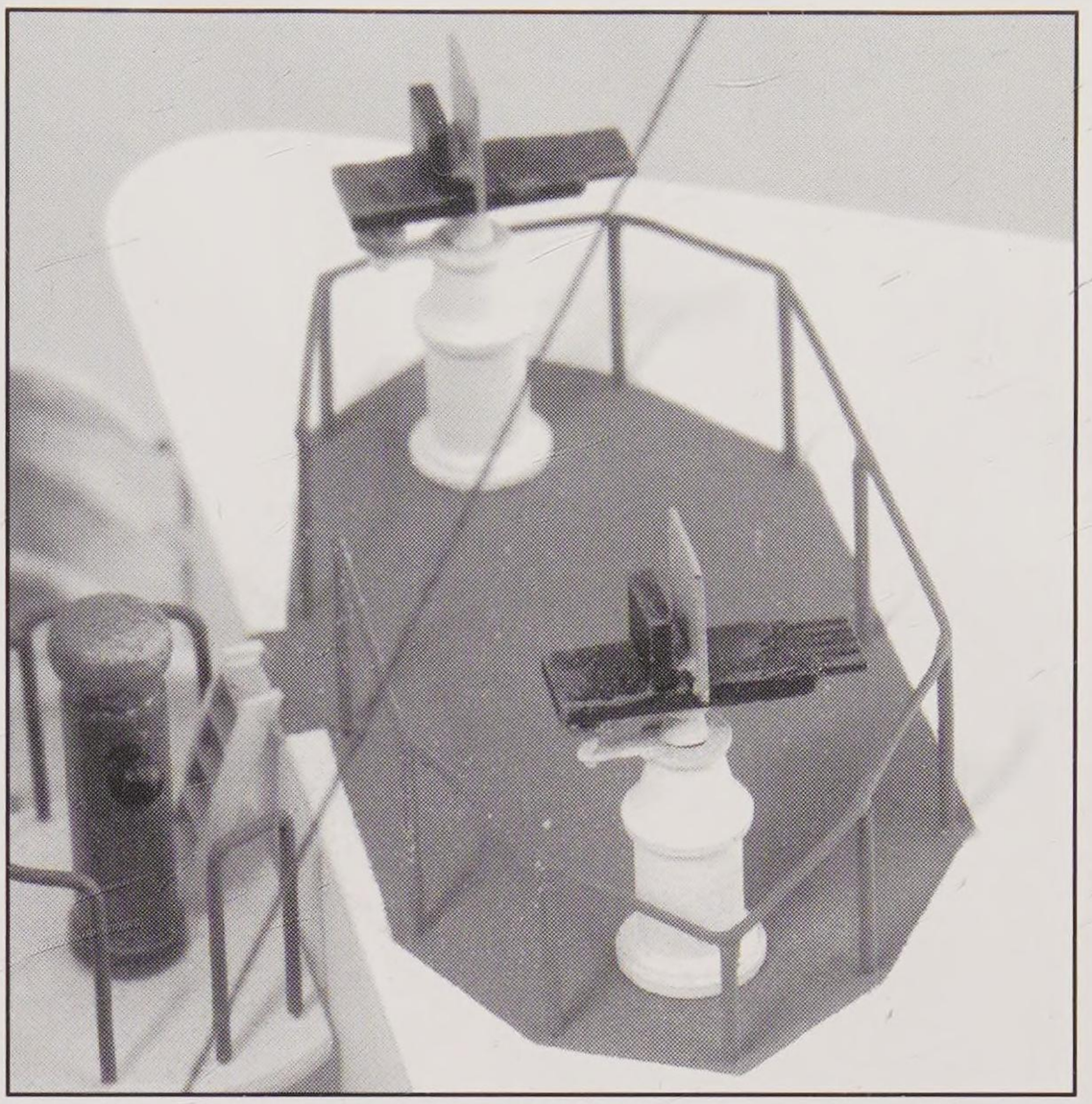


FIG. 8-21: Machine guns on *Victoria*.

to any of the ships I have modeled. This weapon had ten 18" long barrels each with its own firing mechanism. The barrels revolved past a vertical feed for loading, then fired in sequence.

Duilio had several types of small guns unknown to the author. However, it had two Gatling-type weapons, in this case Hotchkiss 37mm revolverkanone. **Fig. 8-22** shows my model of one.

The Maxim gun was adopted late in the period. This freely swinging, continuously firing weapon did not rely on screws for aiming. It was the weapon that caused havoc on the battlefields of Flanders during World War I.

Land weapons

As previously mentioned, no Victorian warship was complete without field artillery. **Fig. 8-23** (c/s) and **Fig. 8-24** show 7-pound weapons on field carriages with their limbers. These were put ashore for land operations.

FIG. 1-4:
HMS Empress of India.

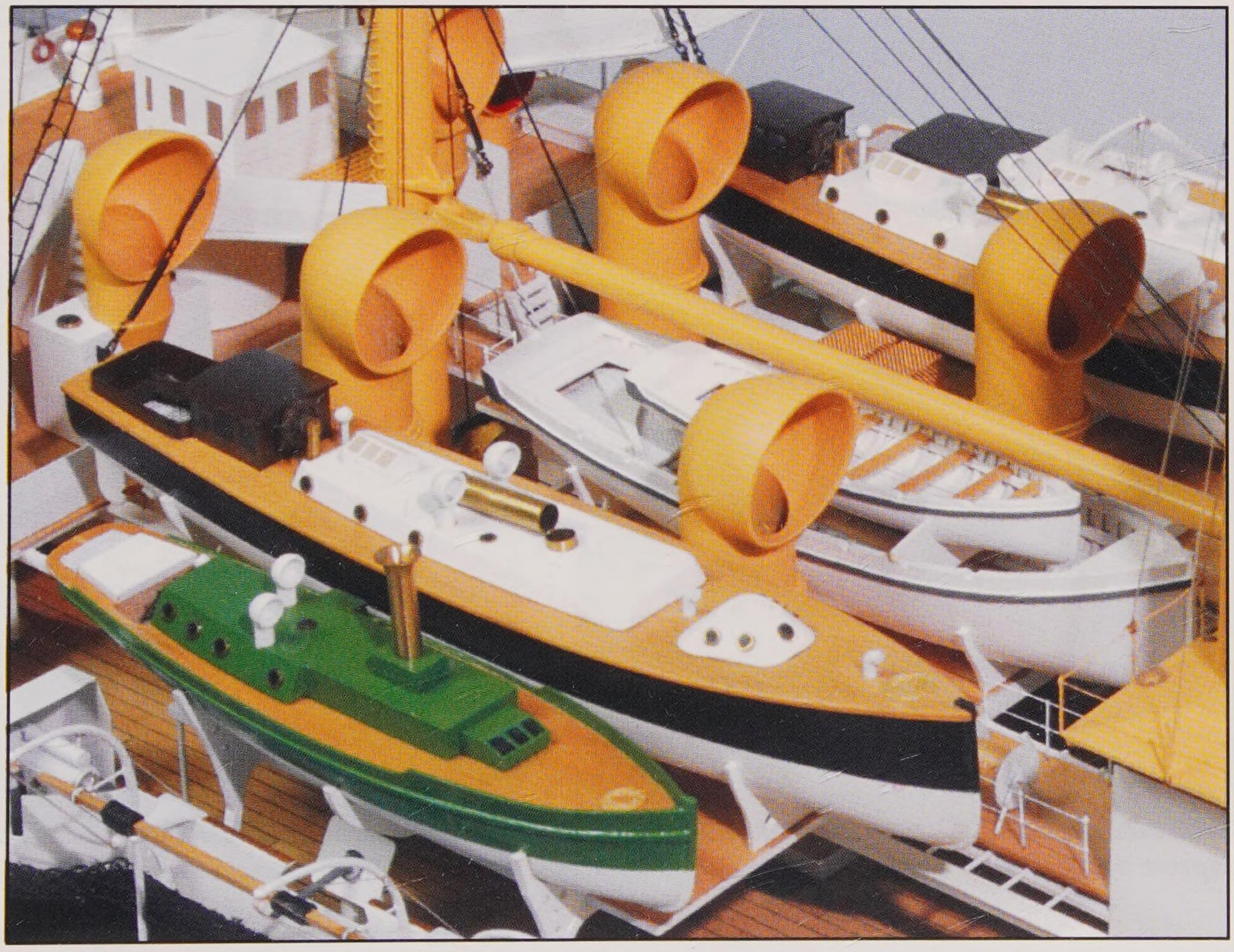


FIG. 10-16:
Forest of ventilators on *Empress of India*.

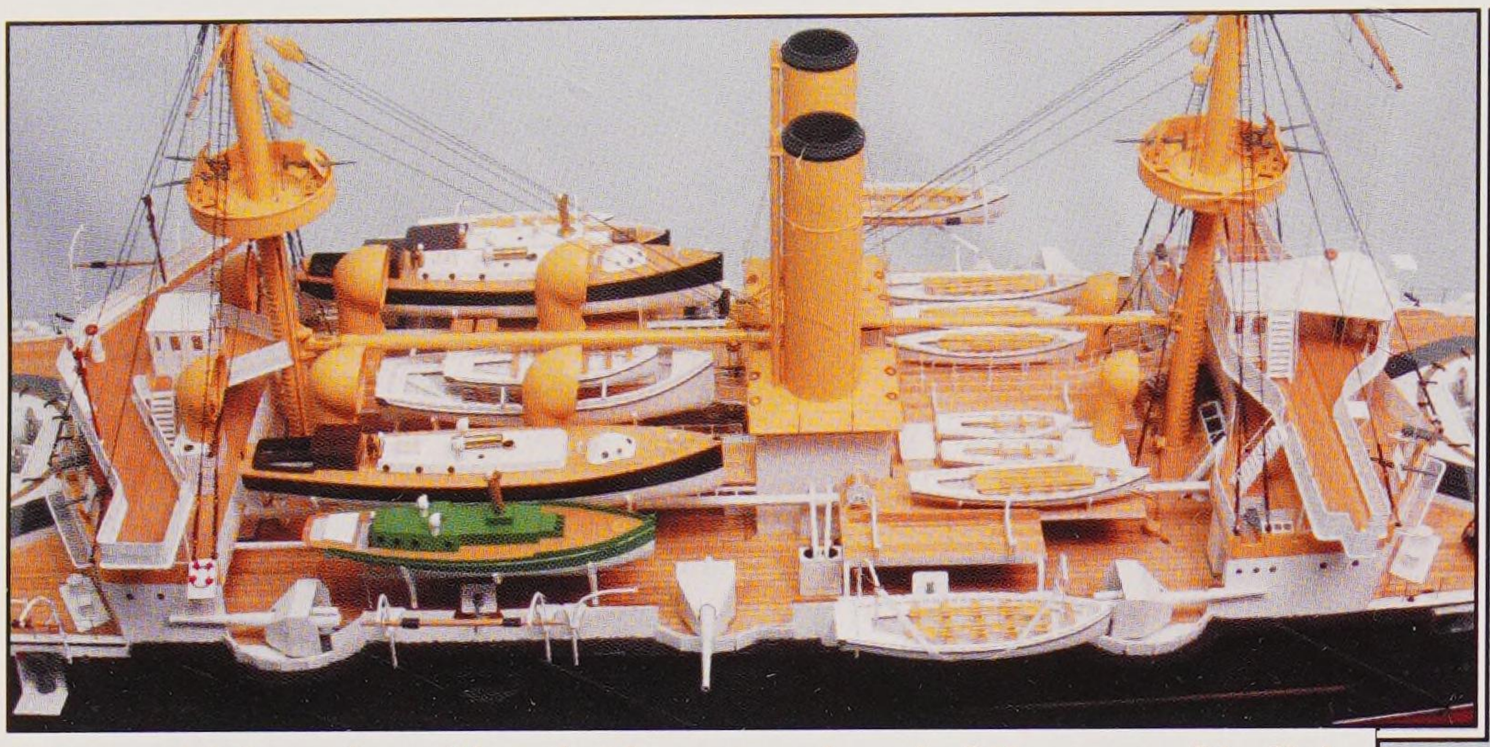


FIG. 4-1: Main and auxiliary bridges at each end of *Empress of India's* boat deck.

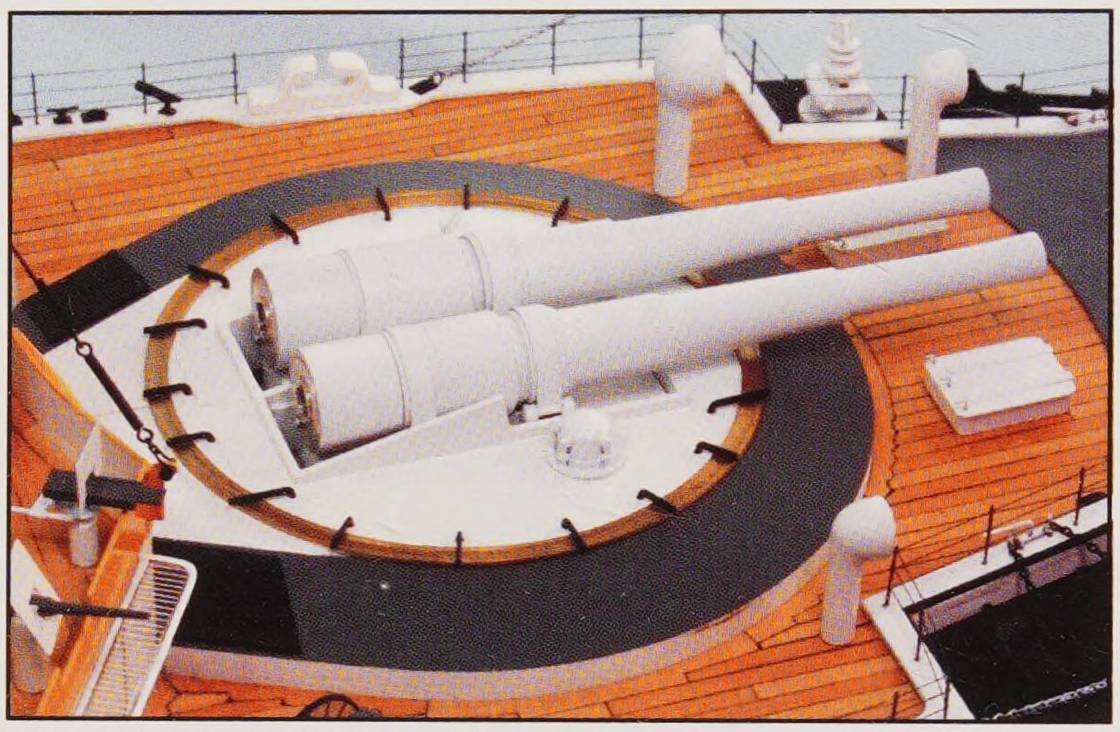


FIG. 7-9: *Empress of India's* barbette-mounted guns without breech mechanism fitted.

FIG. 15-35: *Empress of India* aft.

FIG. 6-16: *Empress of India's* mainmast.

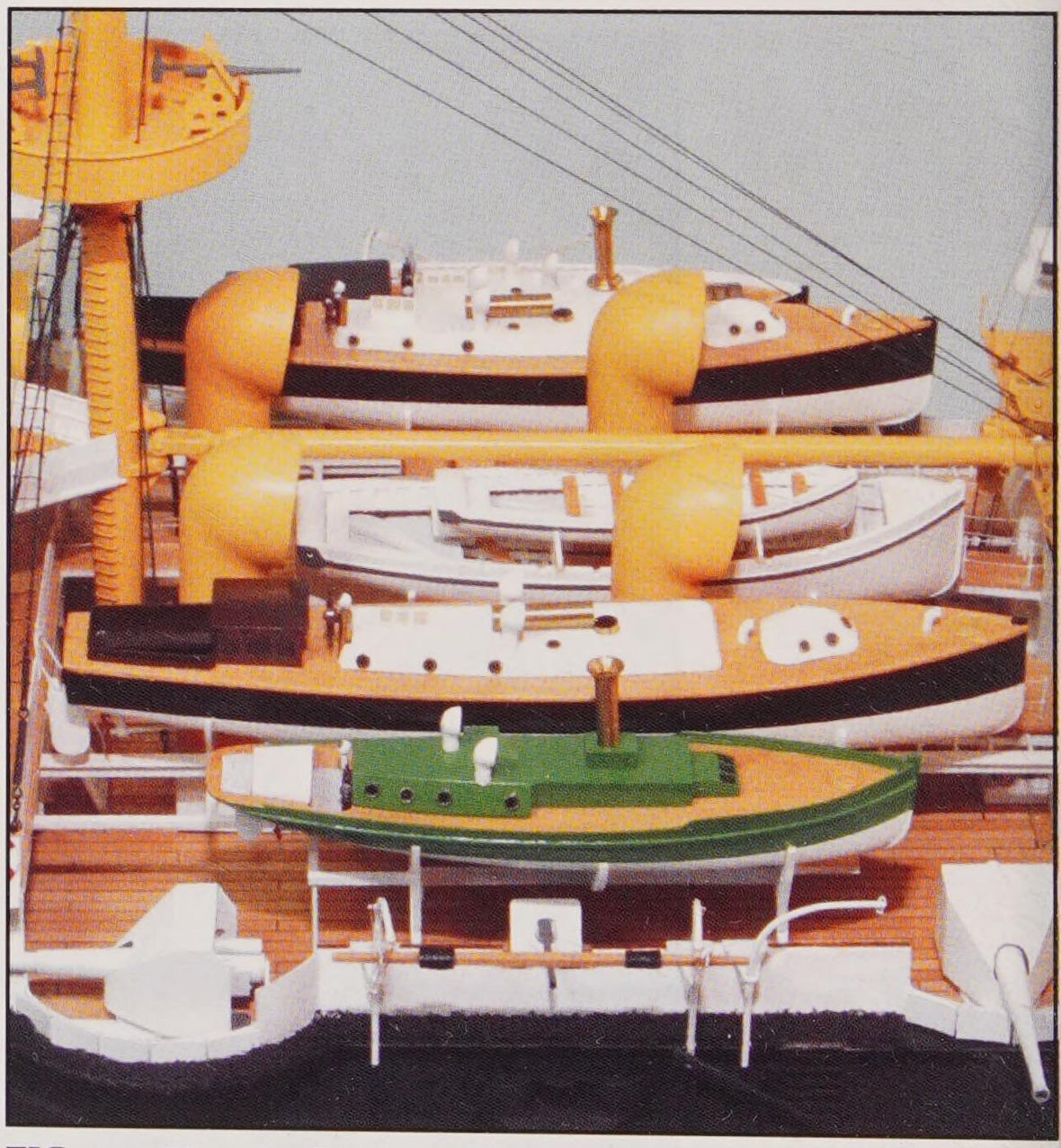


FIG. 9-6: Heavier boats on *Empress of India's* aft stowage.

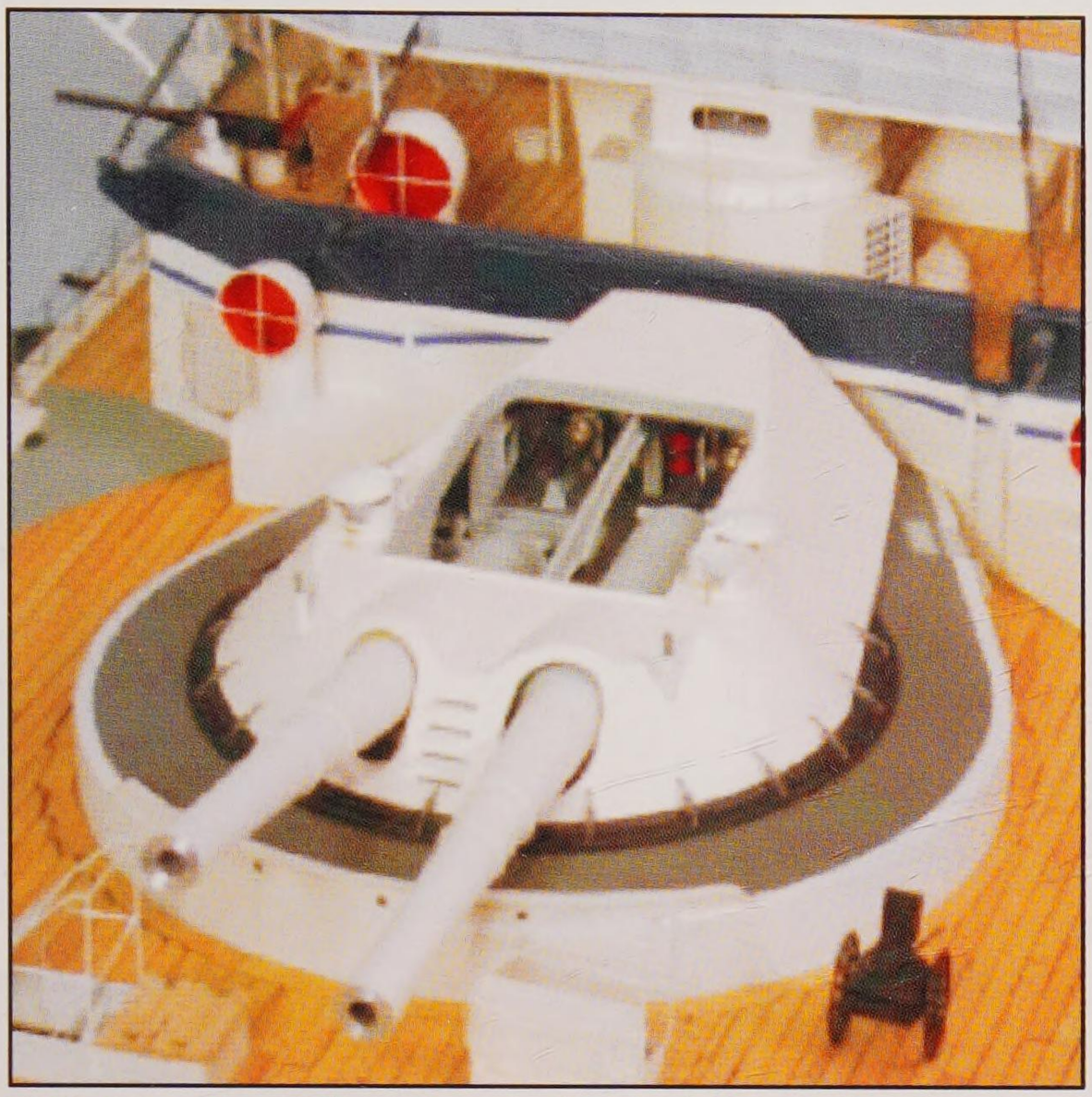


FIG. 7-33: *Magnificent's* completed aft turret showing internal structure.

FIG. 3-30: Bridge wing support on *Magnificent*.

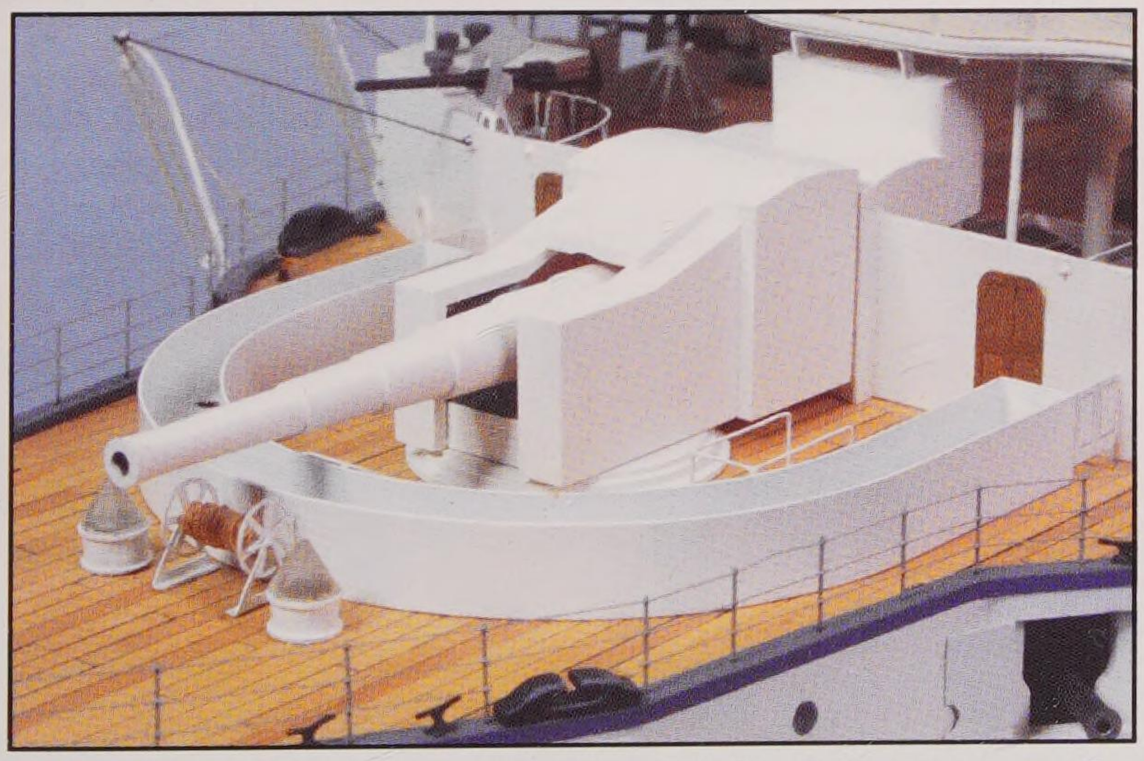


FIG. 7-11: A 10-inch, 29-ton breech-loading gun was the "sting" in *Victoria's* tail.

FIG. 6-2: *Magnificent's* fighting tops with guns, davits, and rung ladder.

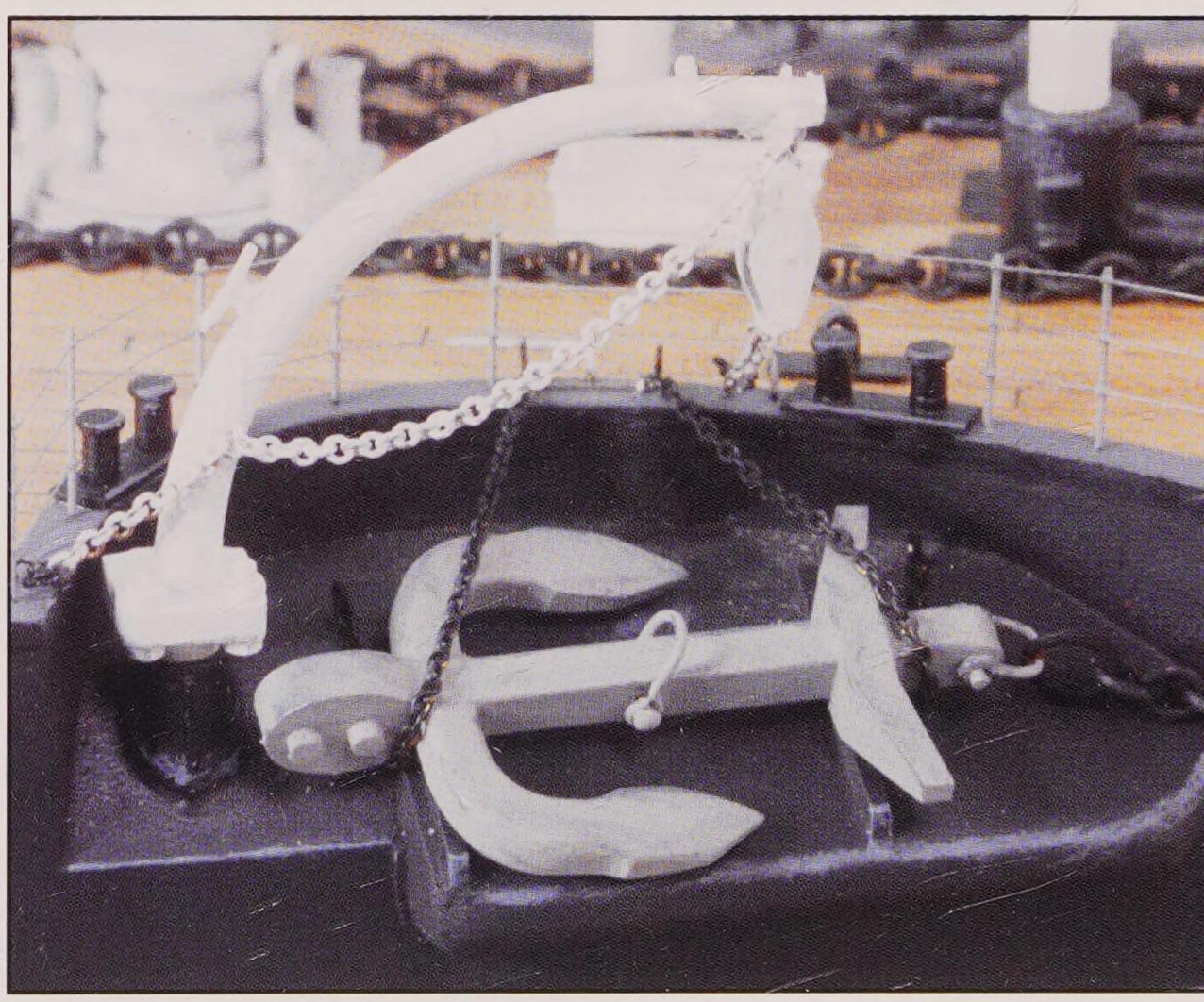


FIG. 11-8: Anchor bed on *Victoria.*

FIG. 1-7: *HMS Victoria's* boat deck.

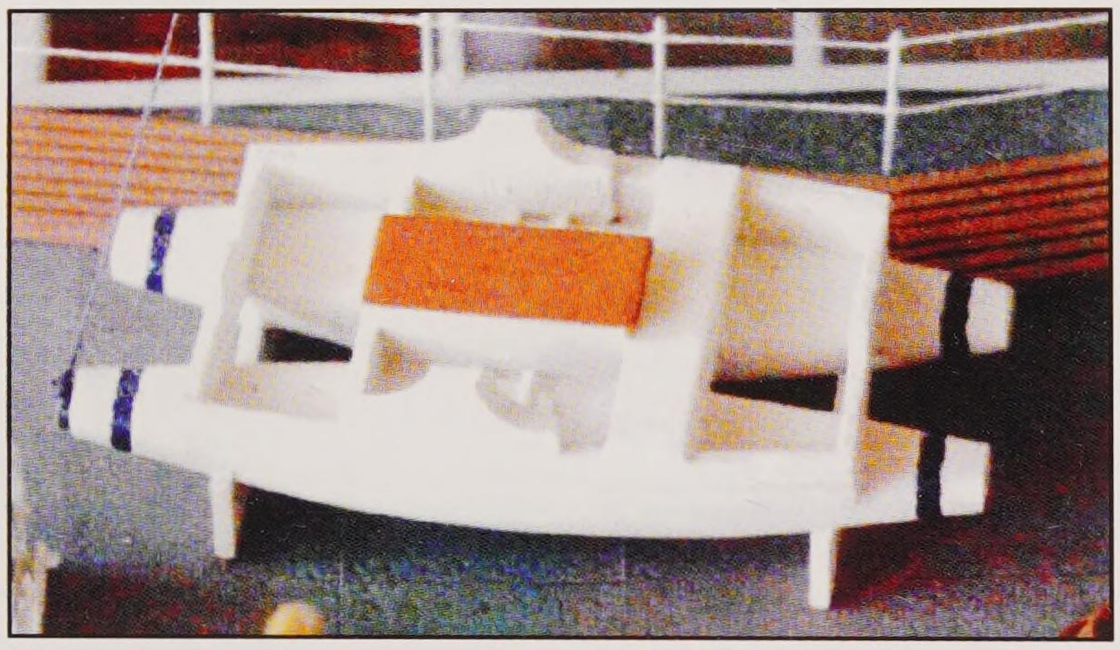


FIG. 15-33: Balsa raft on *Magnificent.*

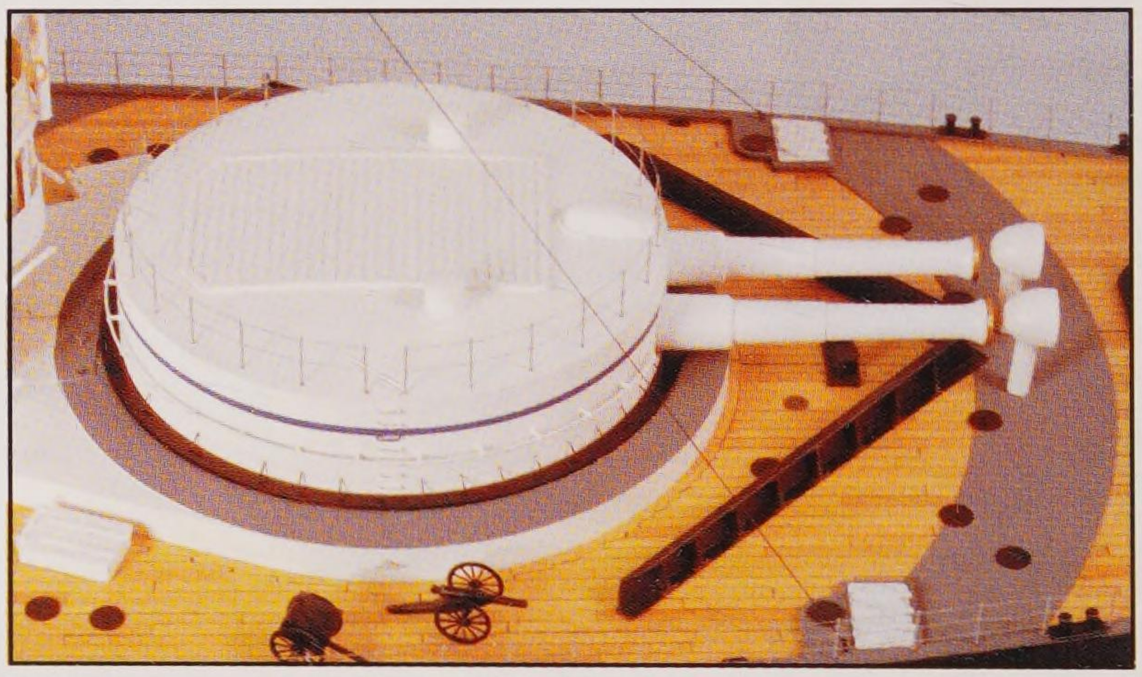


FIG. 14-4: *Victoria's* deck blast plates under gun muzzles.

FIG. 13-27: Guardrail around Admiral's walk on *Victoria.*

FIG. 14-2: *Victoria's* blue strip.

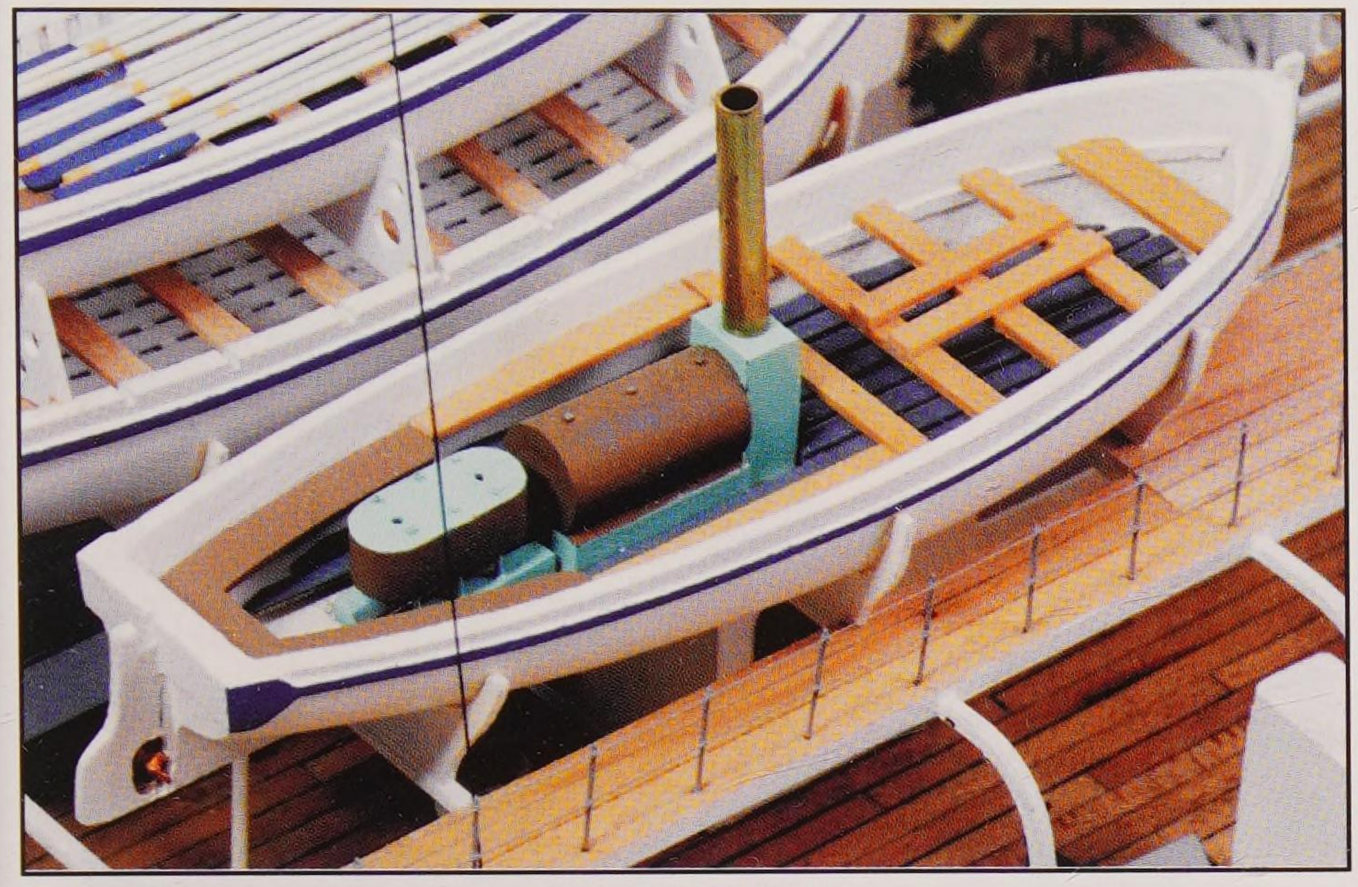


FIG. 9-1: Carved steam launch on *Victoria*.

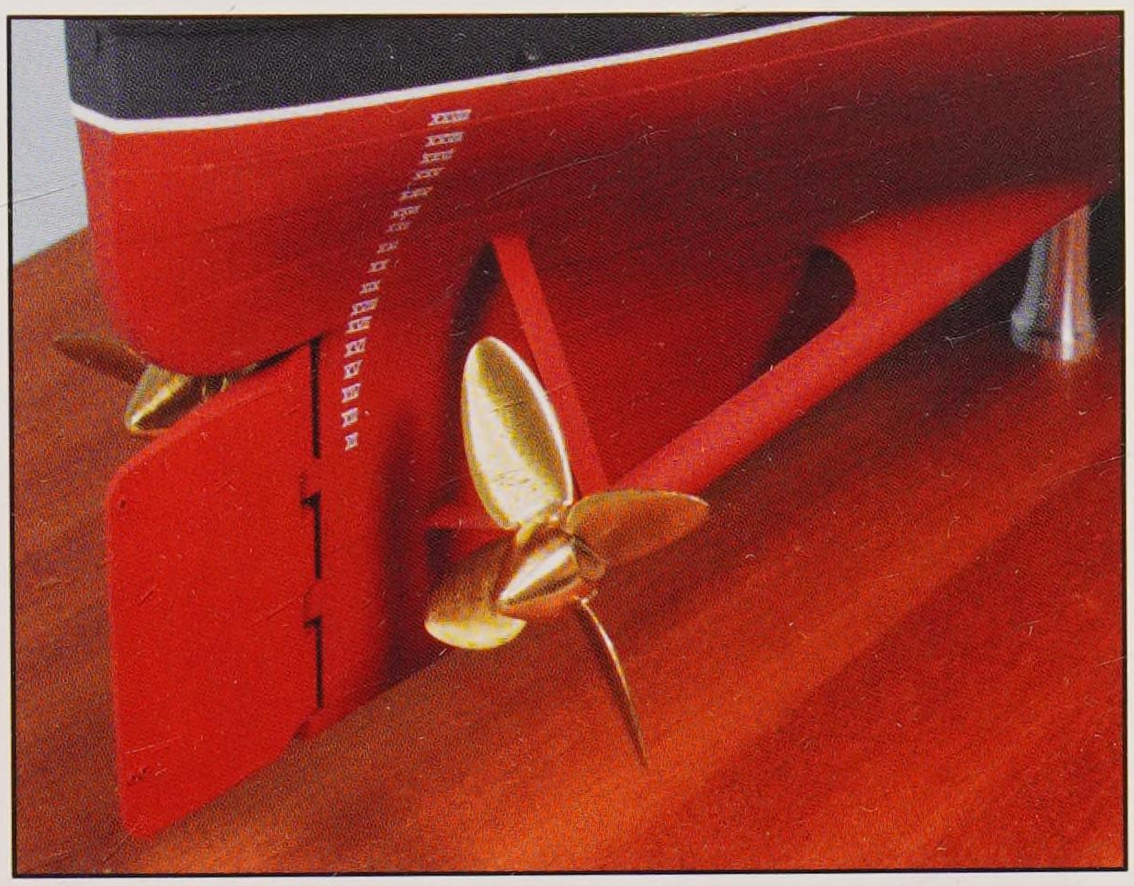


FIG. 12-13: Fitted propeller on *Victoria*.

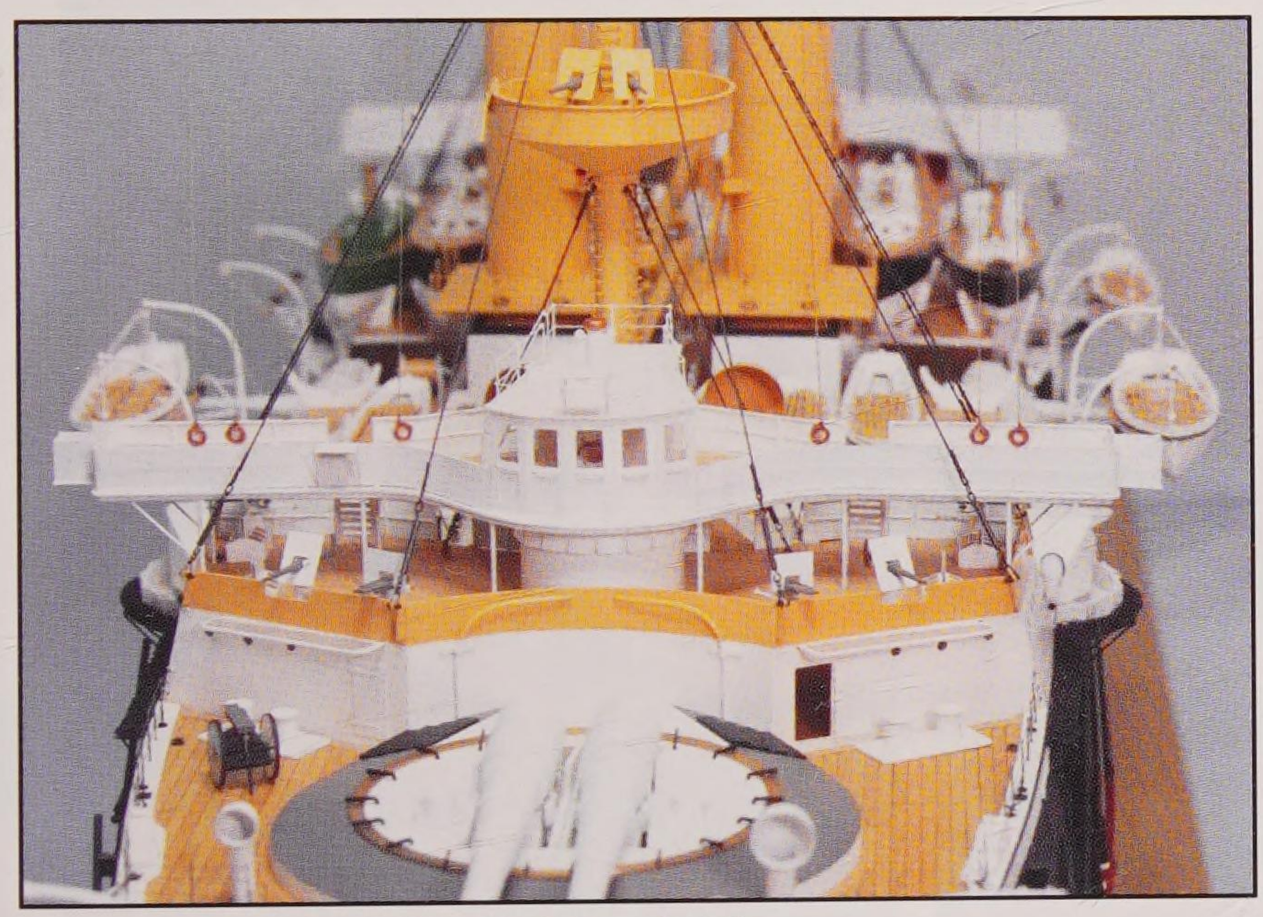


FIG. 4-7: *Empress of India's* fore bridge.

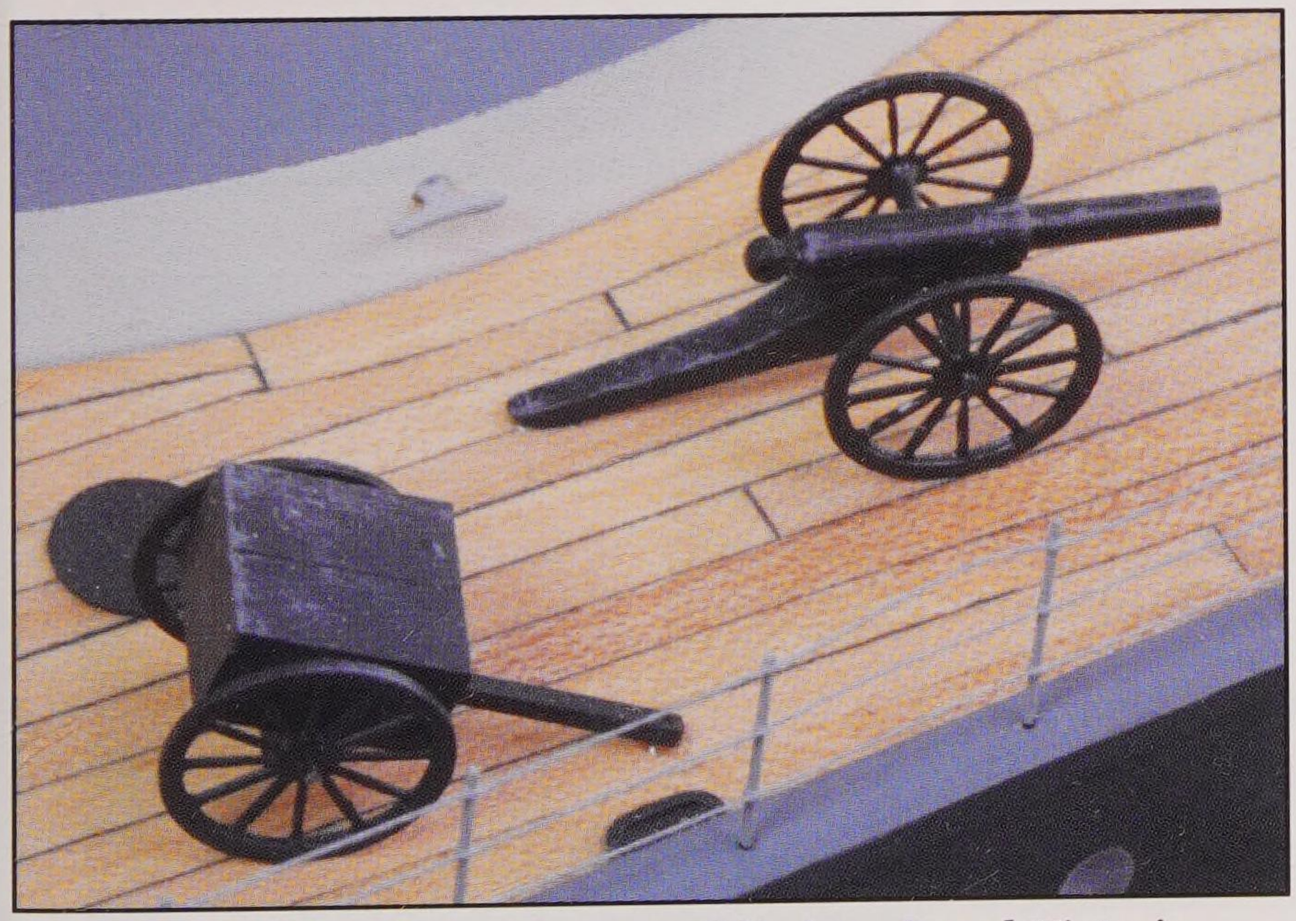


FIG. 8-23: Field artillery cannon and limber aboard *Victoria*.

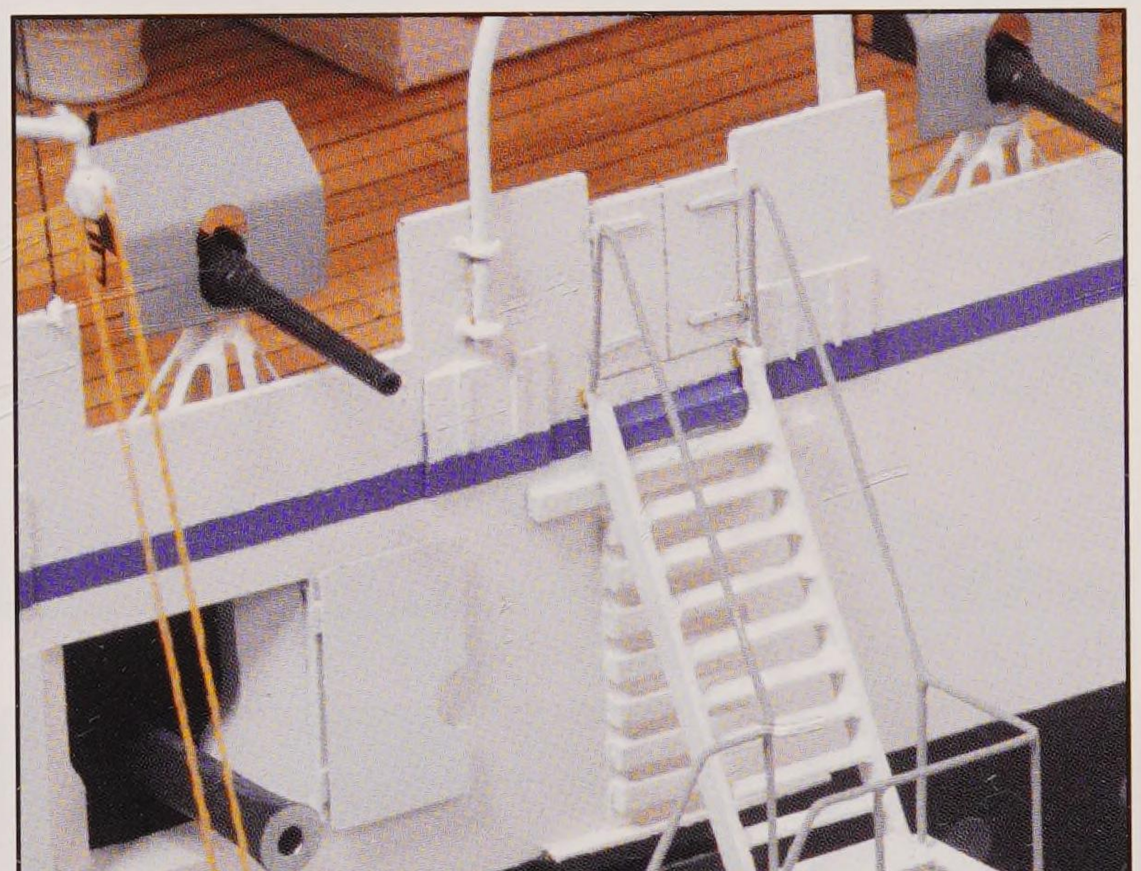


FIG. 15-1: *Victoria's* accommodation ladder.

FIG. 1-9: *HMS Magnificent* amidships.

FIG. 8-5: *Victoria's* battery deck.

FIG. 2-22: *Victoria's* ornamental bow carving.

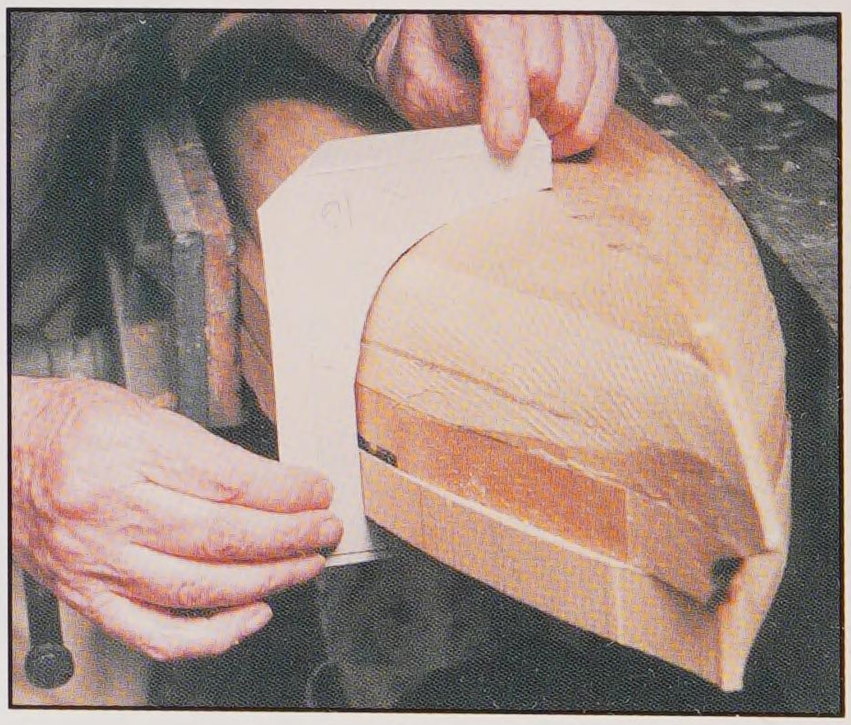


FIG. 2-15. Getting near – trying out the template. Note: I'm holding it at right angles to the keel and not normal to the carved surface.

FIG. 1-11: *RN Duilio*.

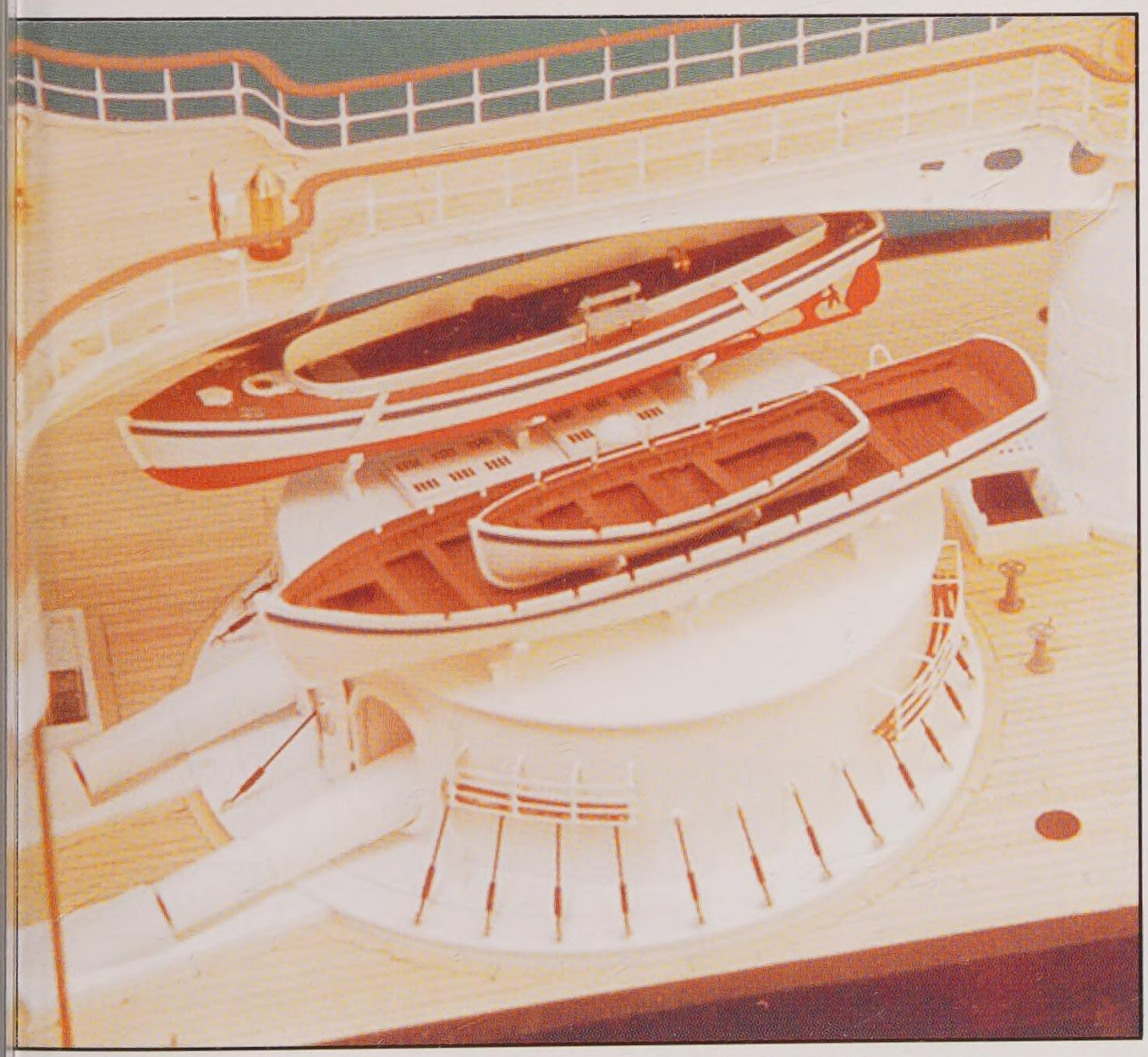


FIG. 9-4: Three finished boats on *Duilio's* starboard turret.

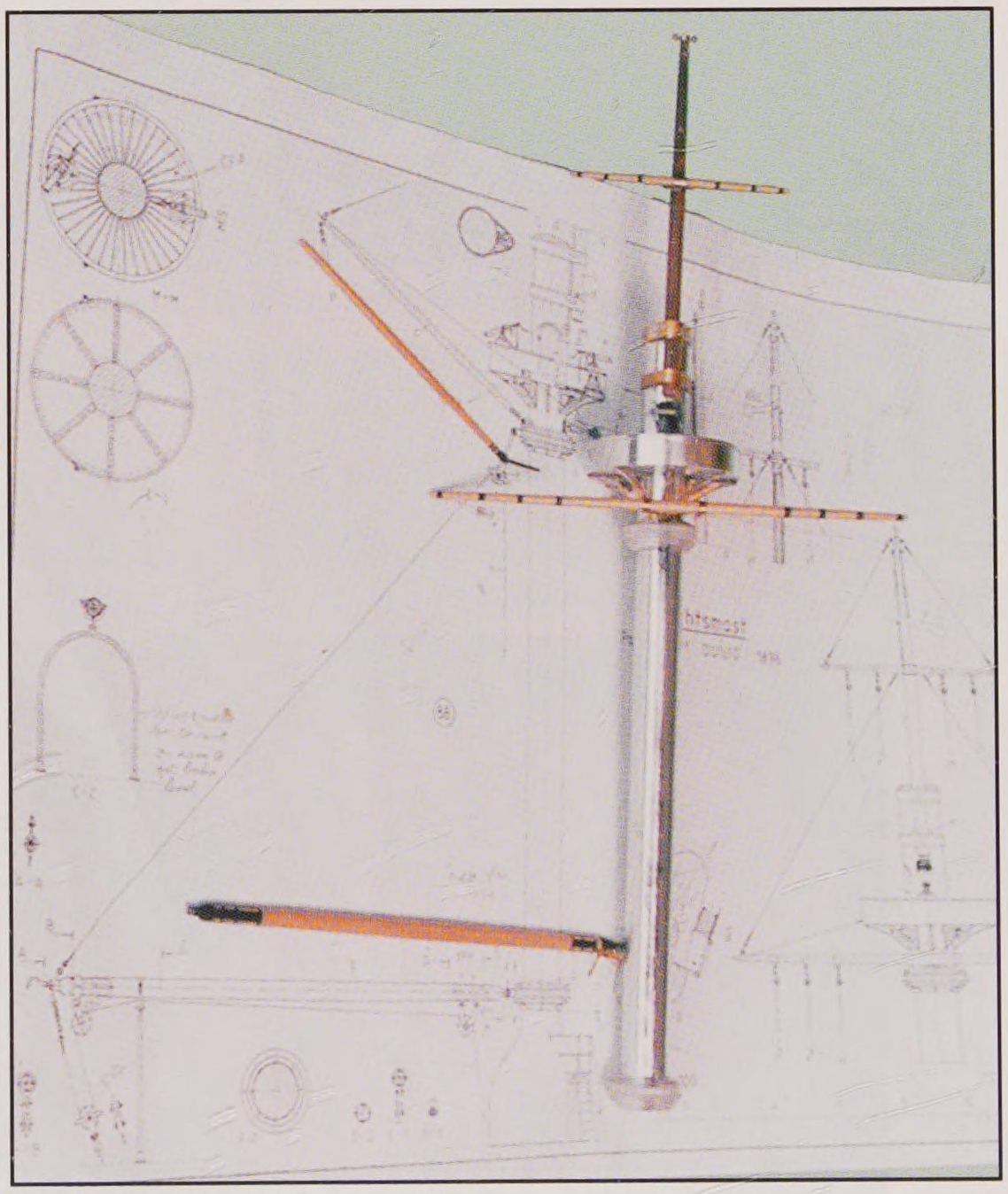


FIG. 6-4: Semi-completed mast for *Duilio*.

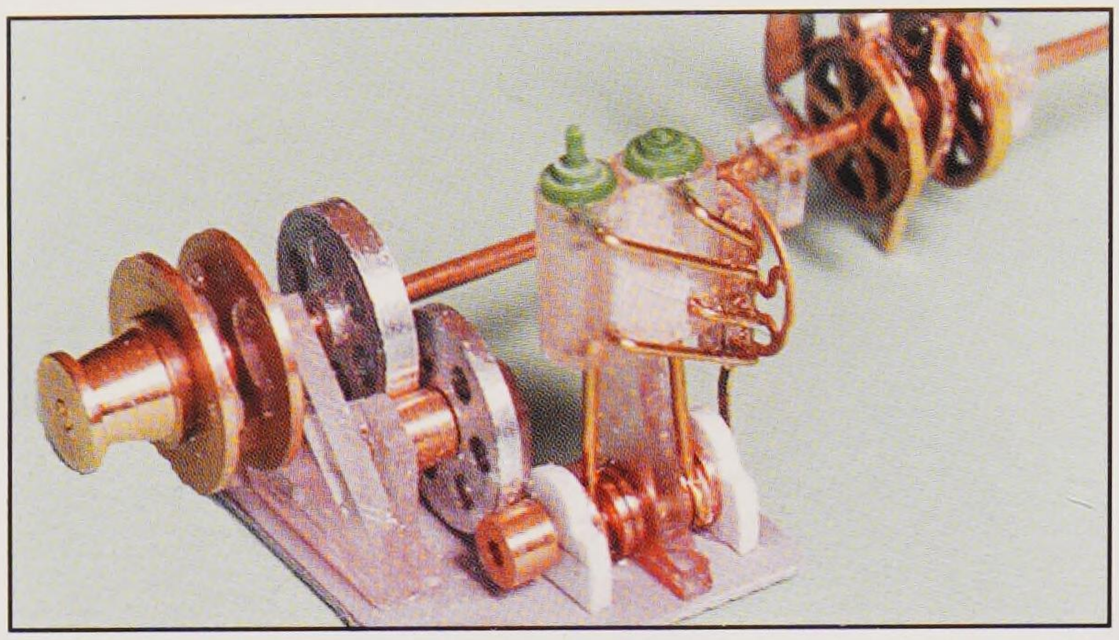
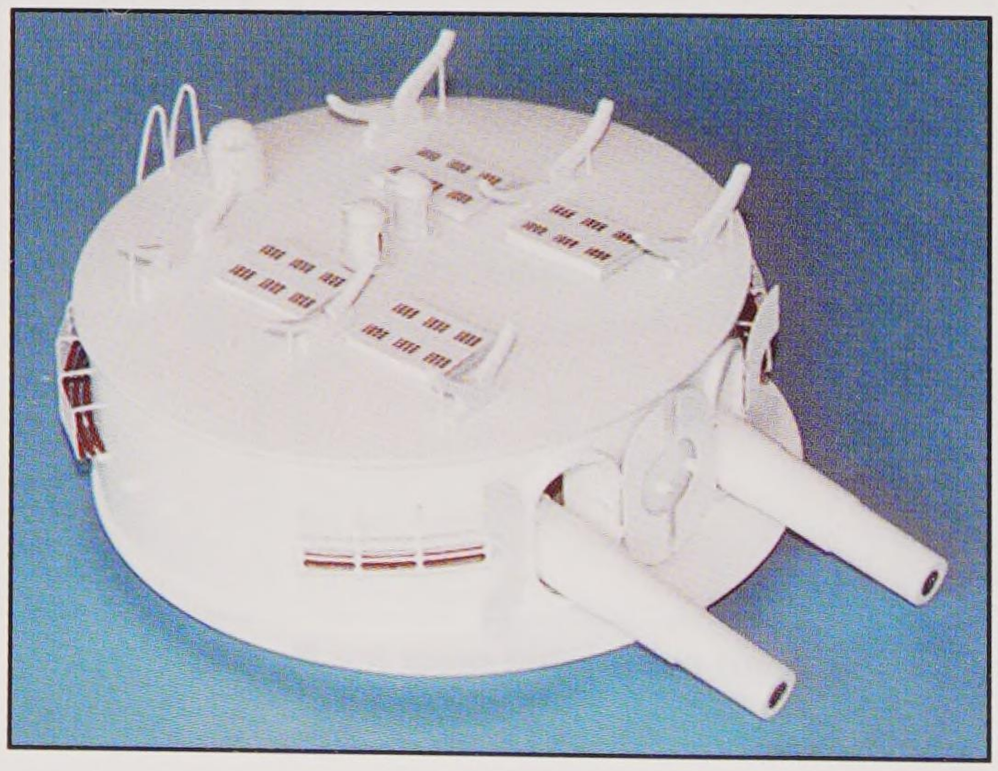


FIG. 4-21: Closeup of the two-cylinder steam engine with band brakes and clutch mechanism in the background. Length of engine bed plate is 18mm (23/32").

FIG. 5-11: *Duilio's* aft funnel.



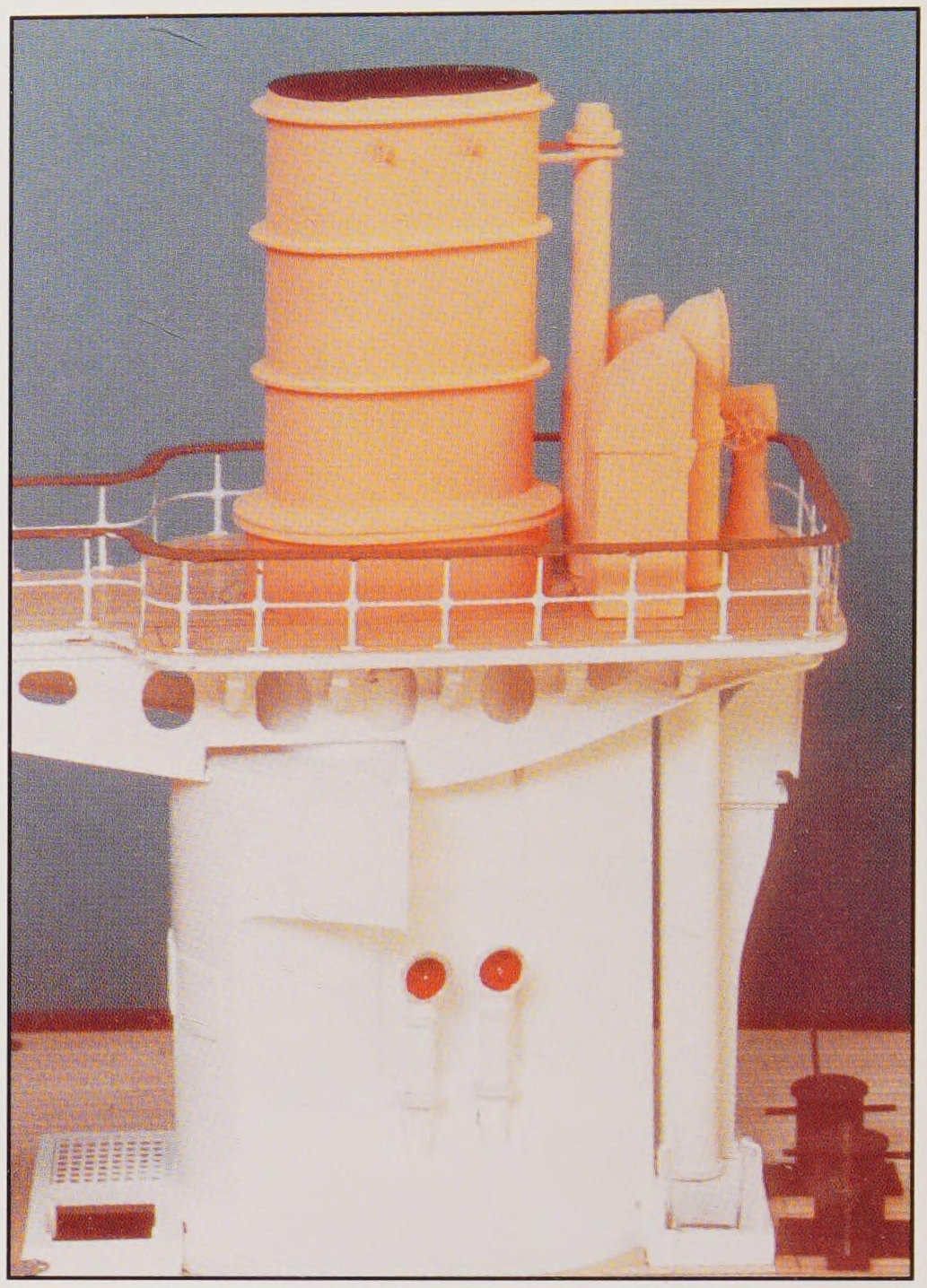


FIG. 5-7: *Duilio's* starboard fore funnel.

FIG. 8-14 (above): *Magnificent's* fighting top with three quick firers.
FIG. 7-13 (left): *Duilio's* turret with skylights.

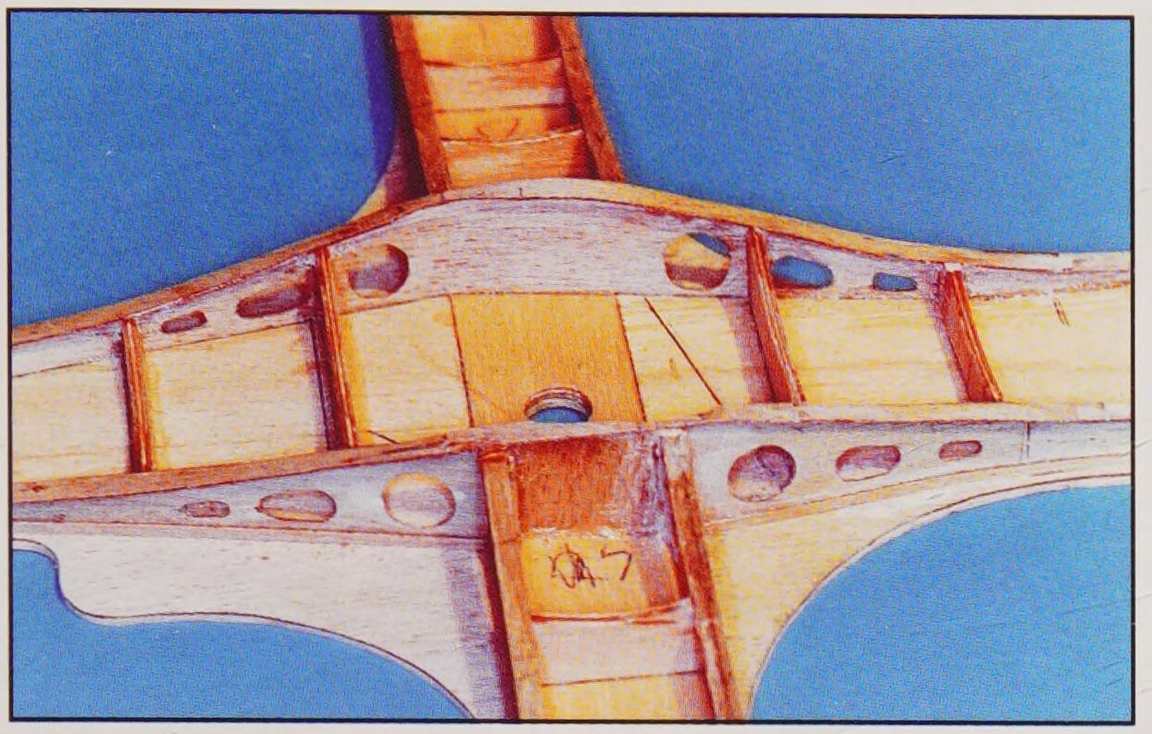


FIG. 3-17: Flying deck structure that lies over *Duilio's* conning tower. Shown upside down.

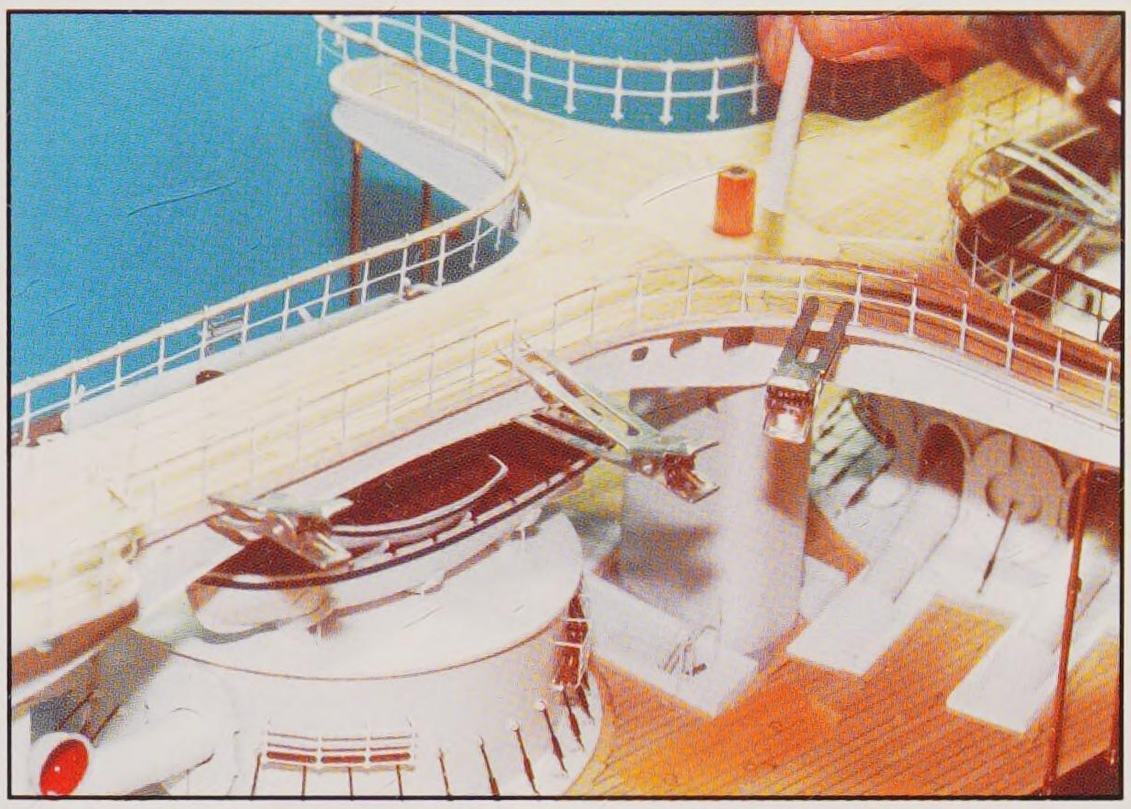


FIG. 3-28: Final assembly of guardrails to *Duilio's* flying deck. Note the use of hair clips to clamp the assembly.

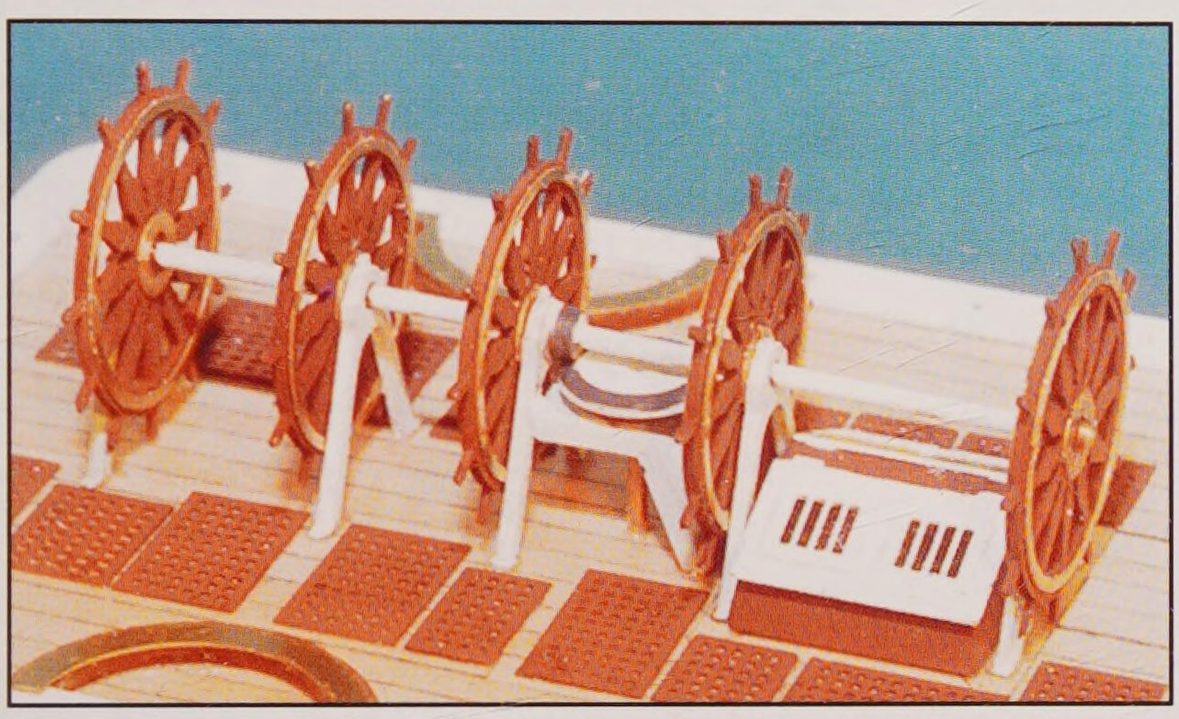


FIG. 13-9: *Duilio's* ship's wheel assembly painted and fitted.

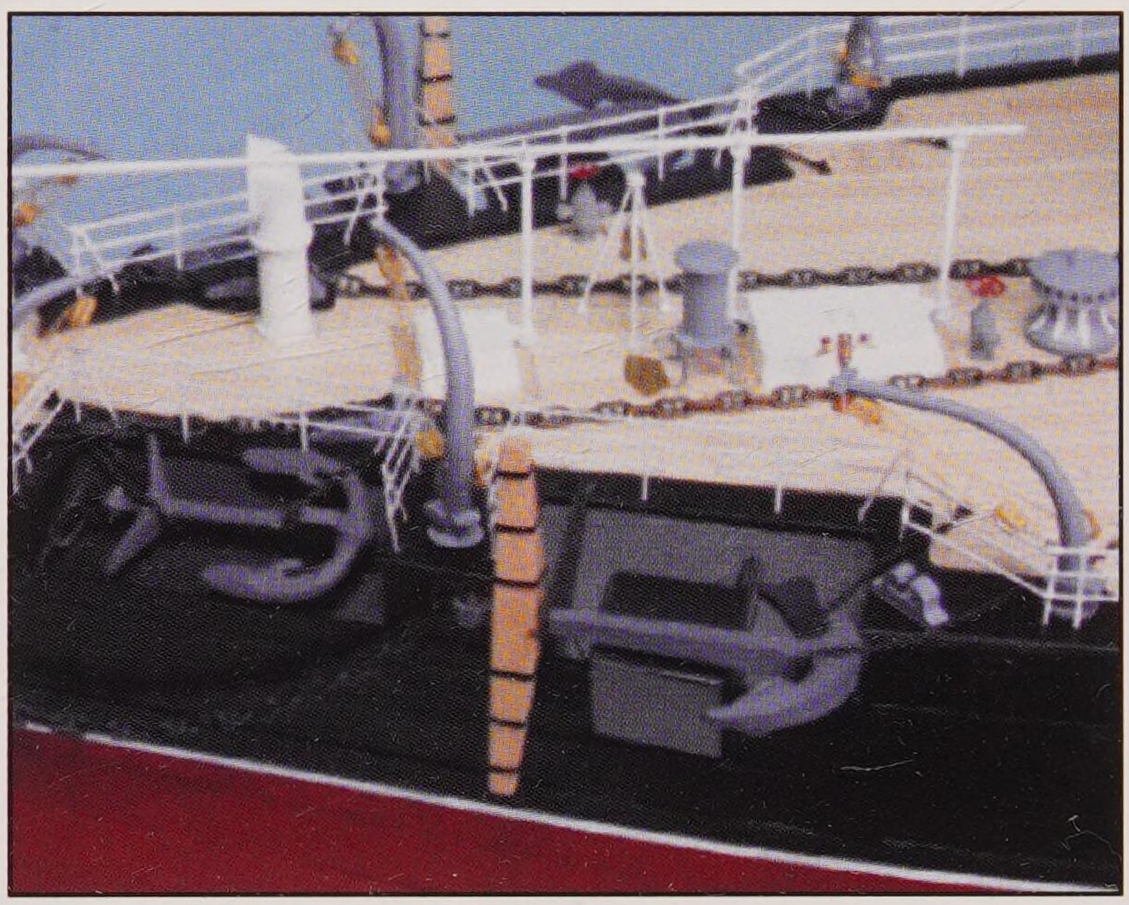


FIG. 11-19: Anchors stowed on *Duilio*.

FIG. 14-14: Canvas dodgers on *Victoria*.

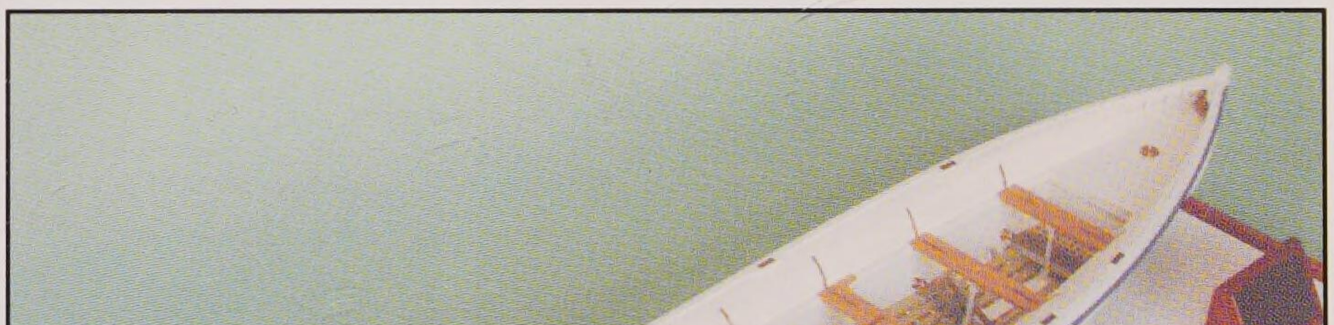


FIG. 9-3: My model of a 30-foot Royal Navy life gig.

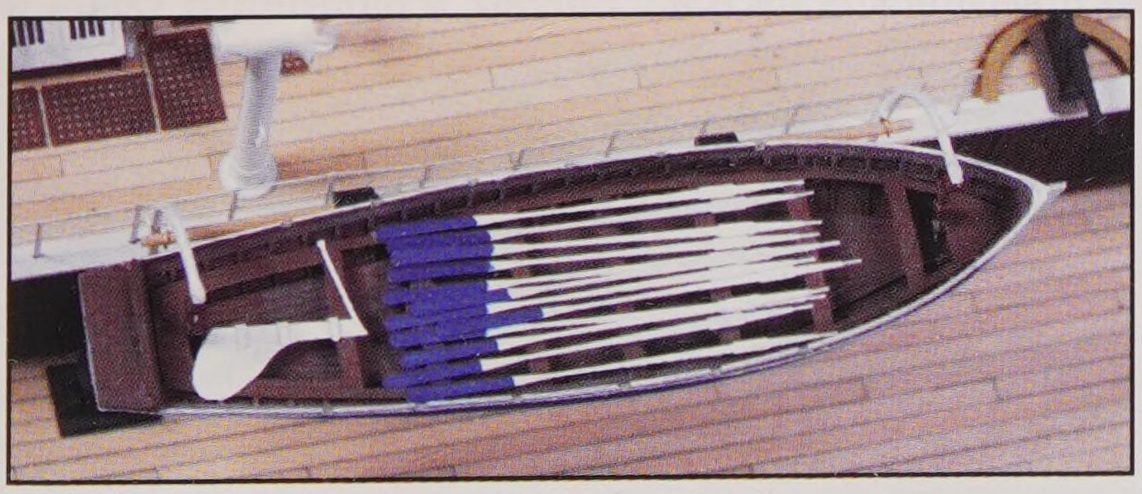


FIG. 9-20: Rudder stowed in stern sheets.

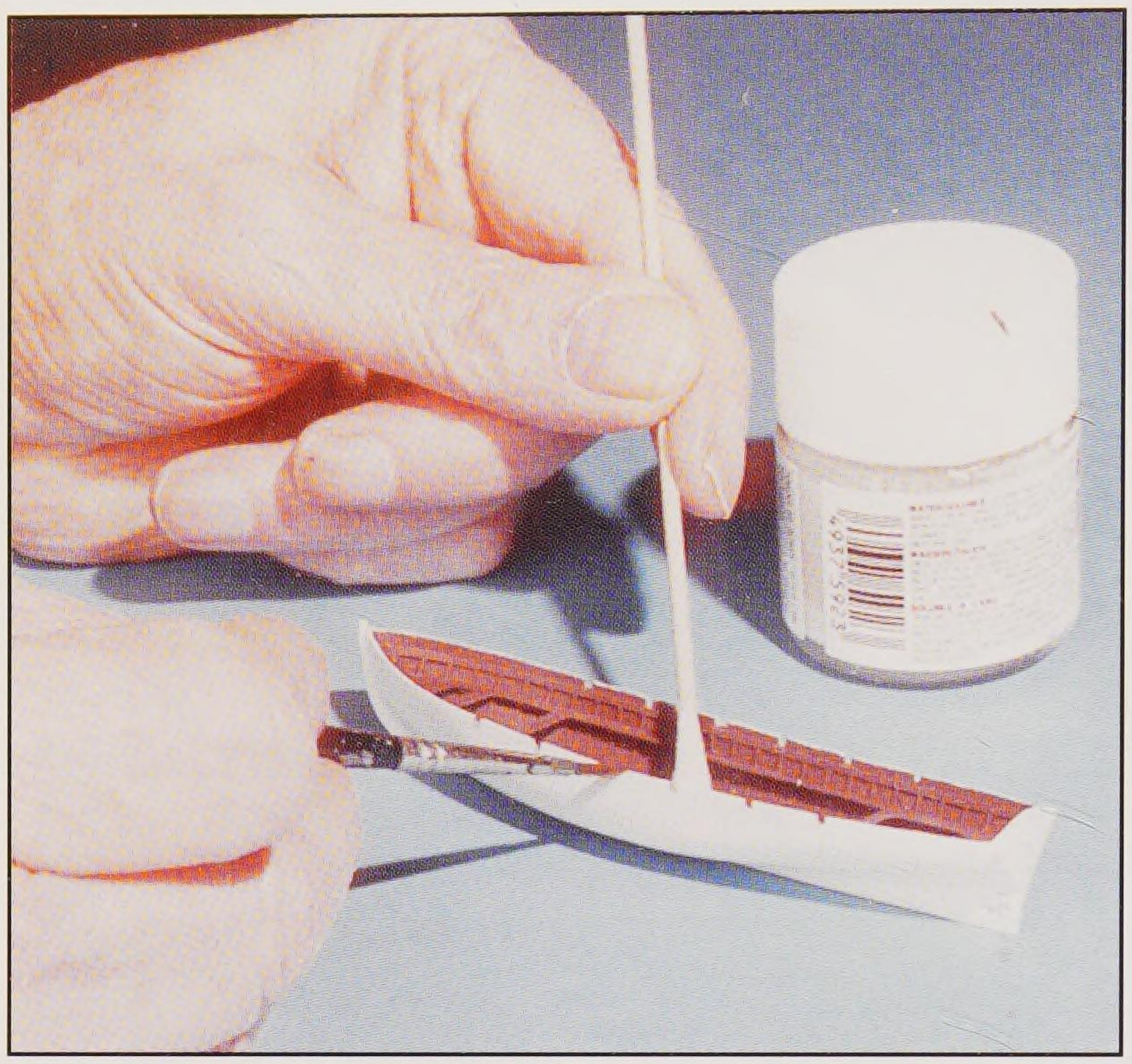


FIG. 14-12: Painting the gunnel on a ship's boat.

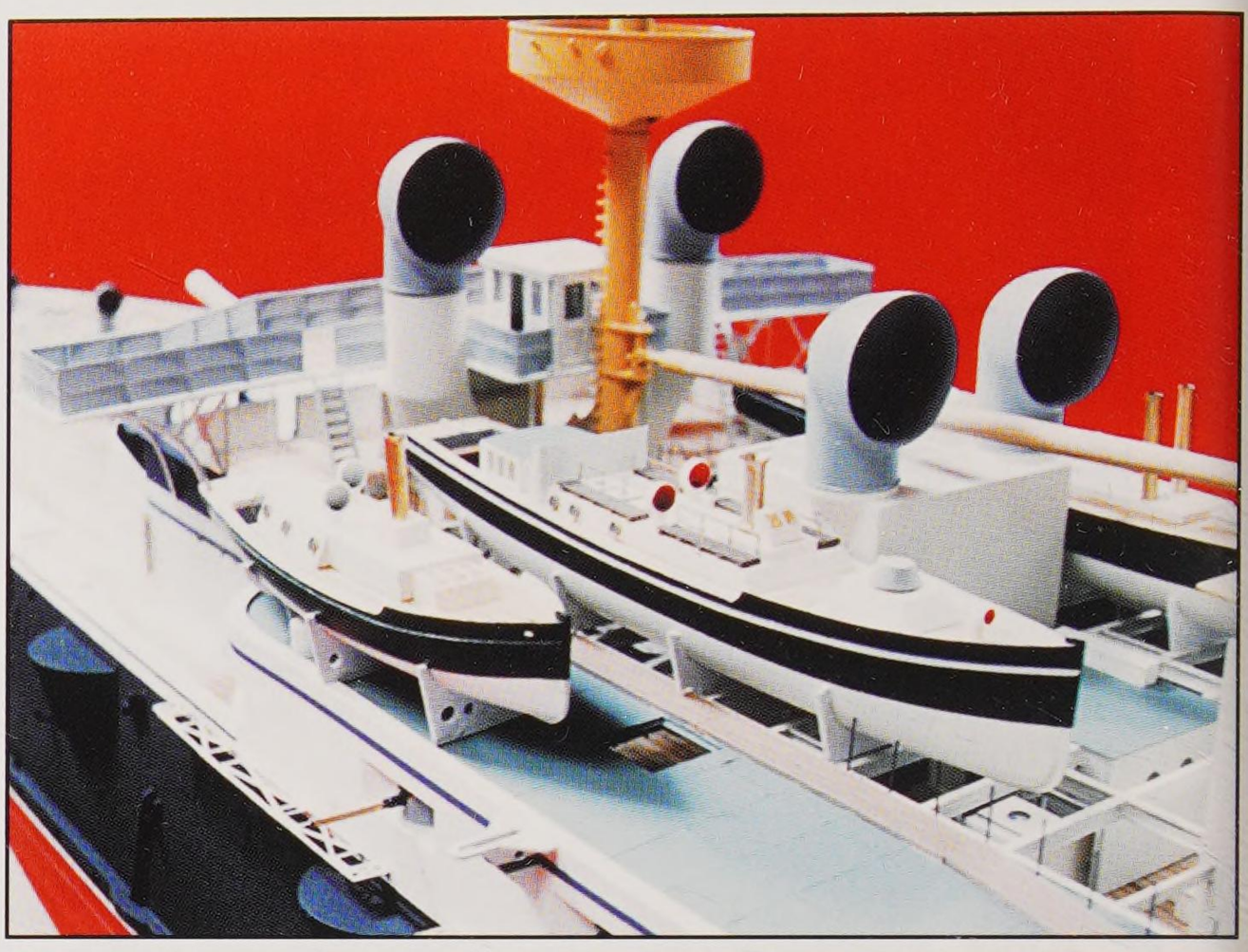


FIG. 10-1: Large cowl ventilators on unfinished model of *Magnificent*. They were made from copper by the tin-bashing method.

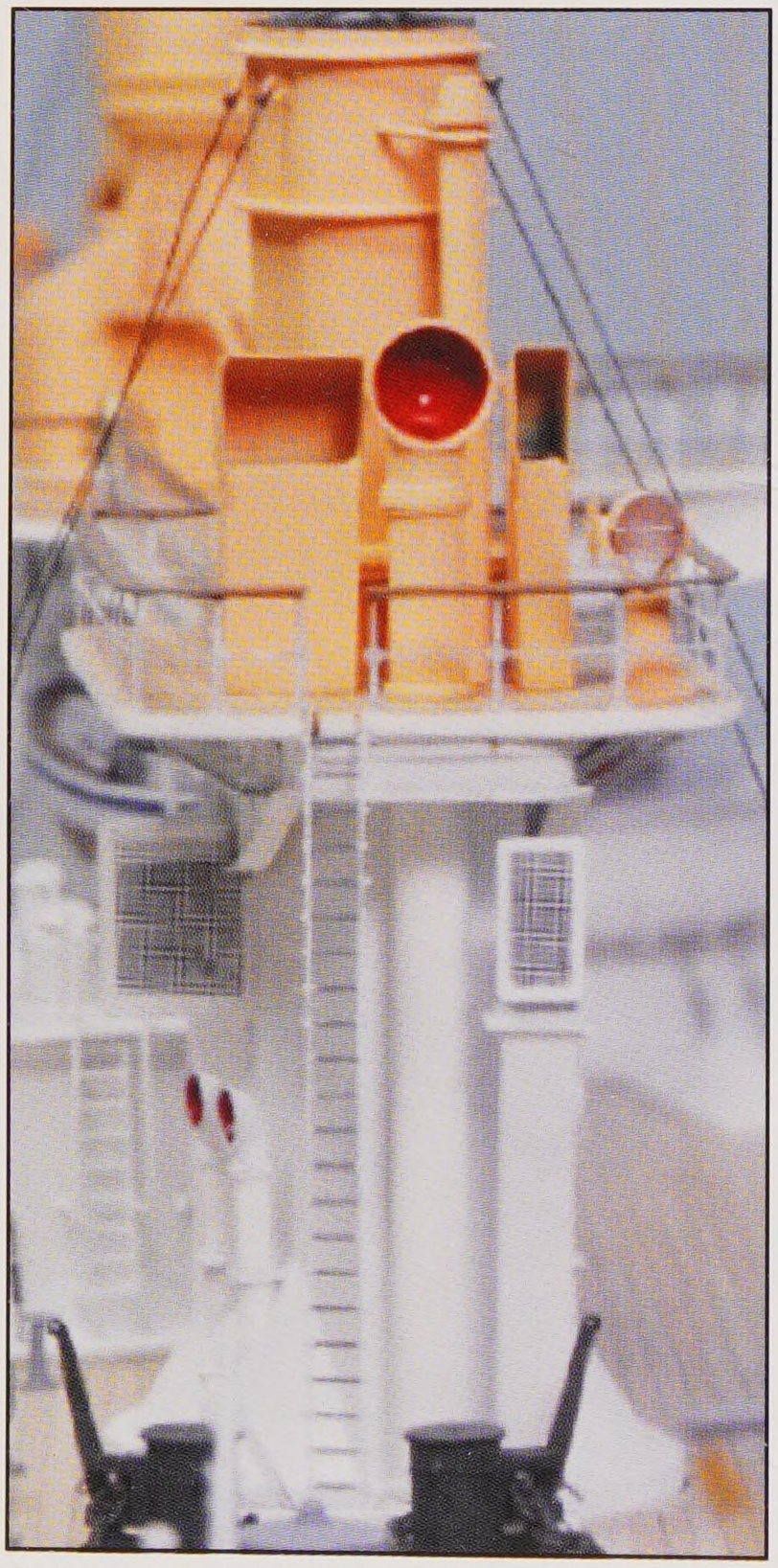


FIG. 10-14: Collection of vents on *Duilio*.

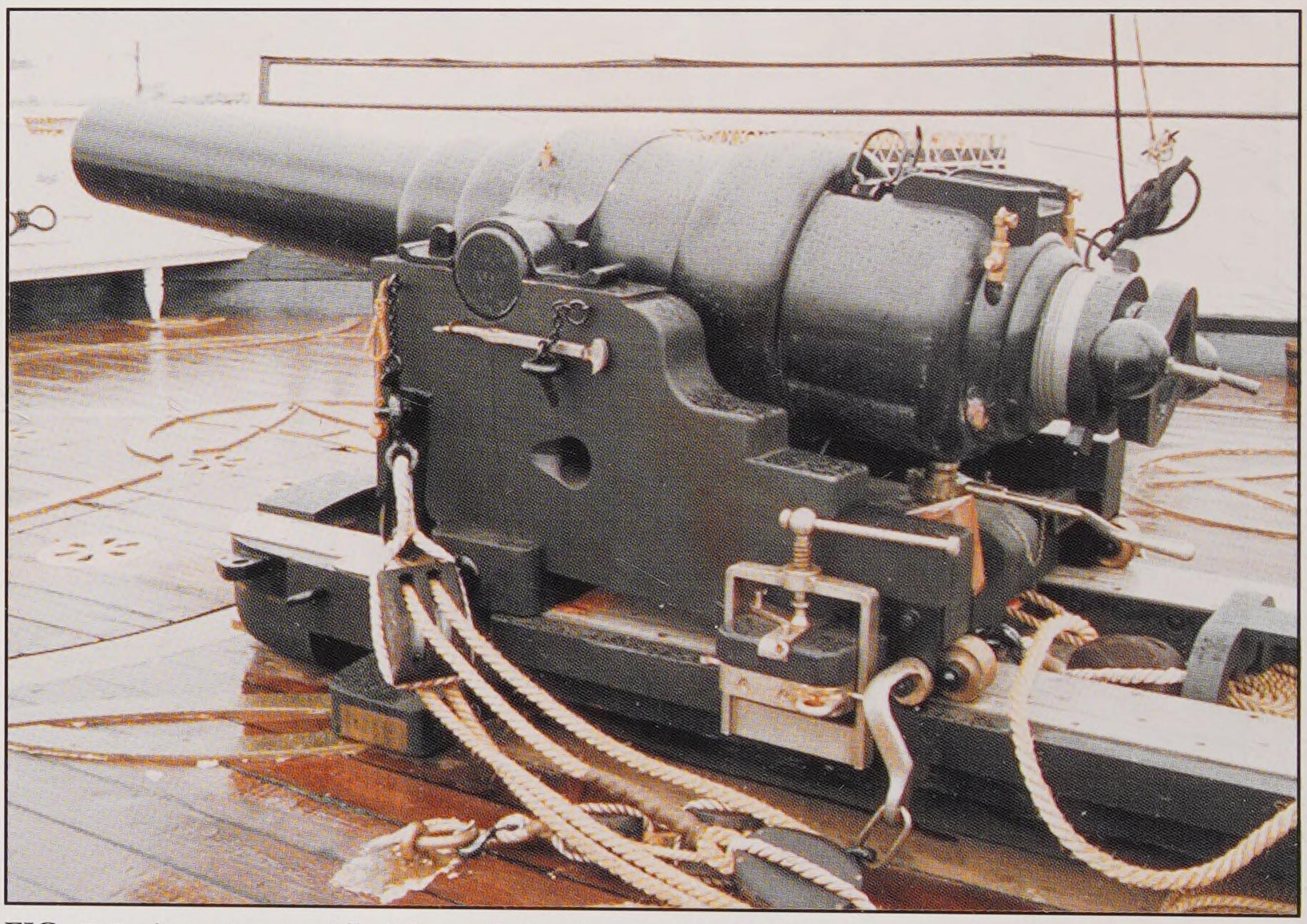


FIG. 7-5: Armstrong rifled breech-loader on *HMS Warrior*, a refurbished 1860's warship berthed in Portsmouth dockyard.

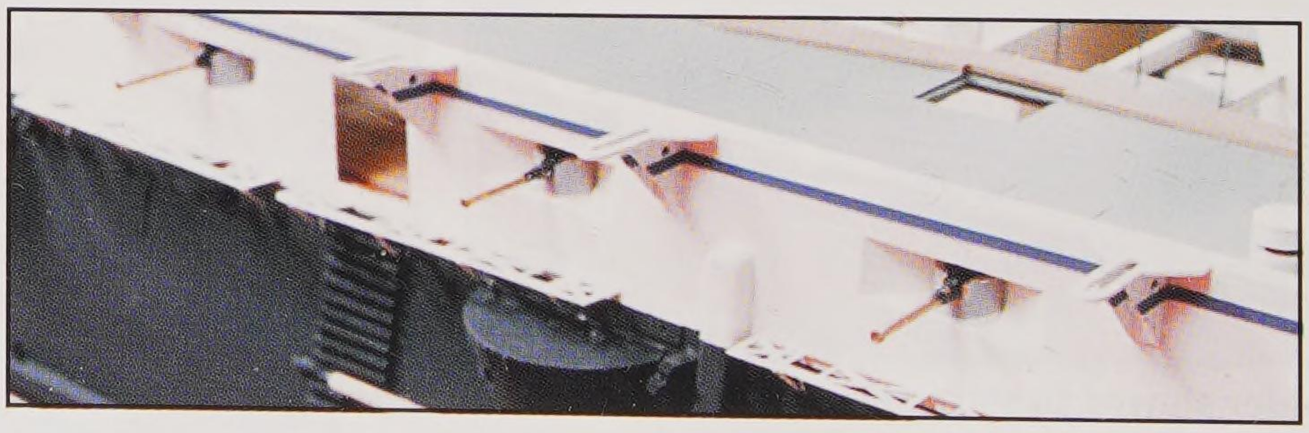


FIG. 4-3: Closeup of casemated secondary armament on uncompleted *Magnificent*. See Ch 4.

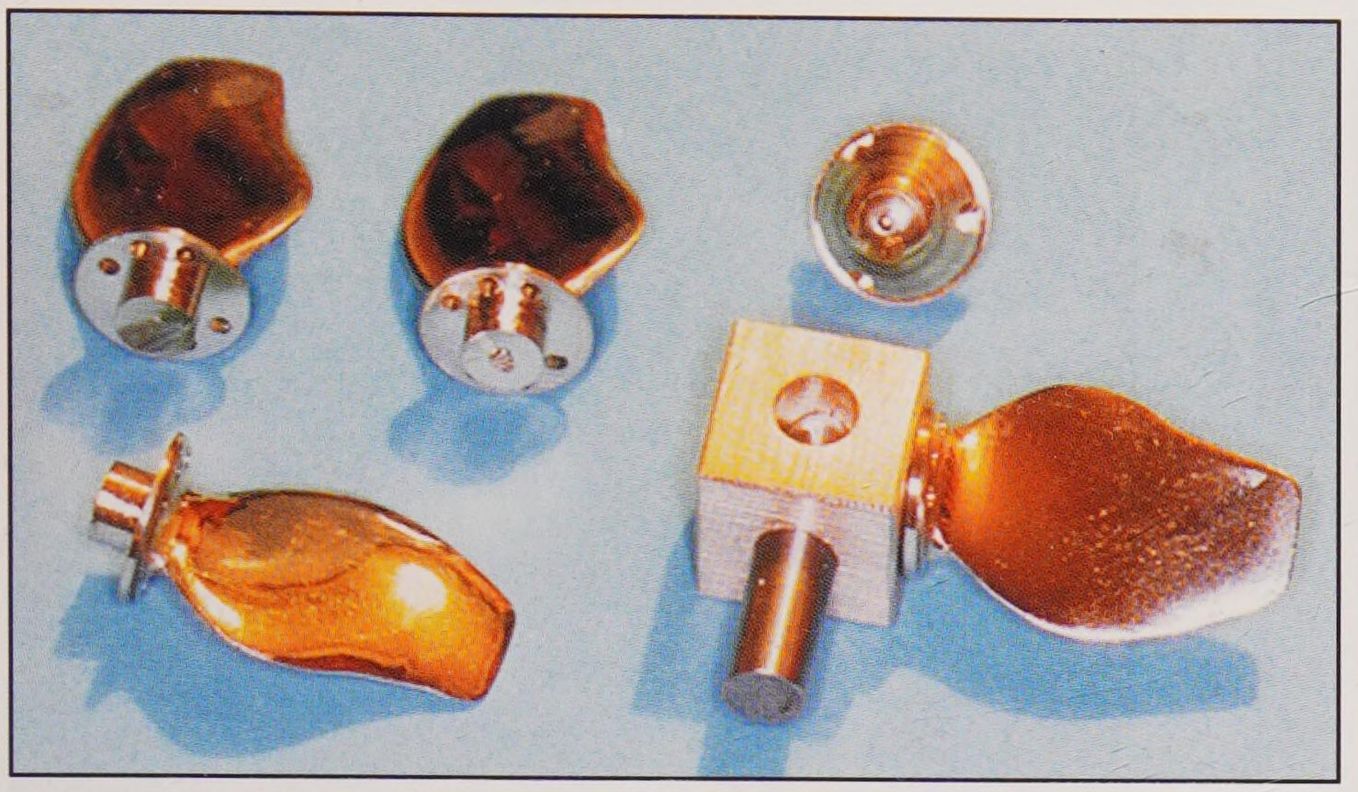


FIG. 12-5: All the parts for one of *Duilio's* propellers.

FIG. 4-5: *Victoria's* enclosed bridge.

FIG. 15-5: *Victoria's* accommodation ladder.

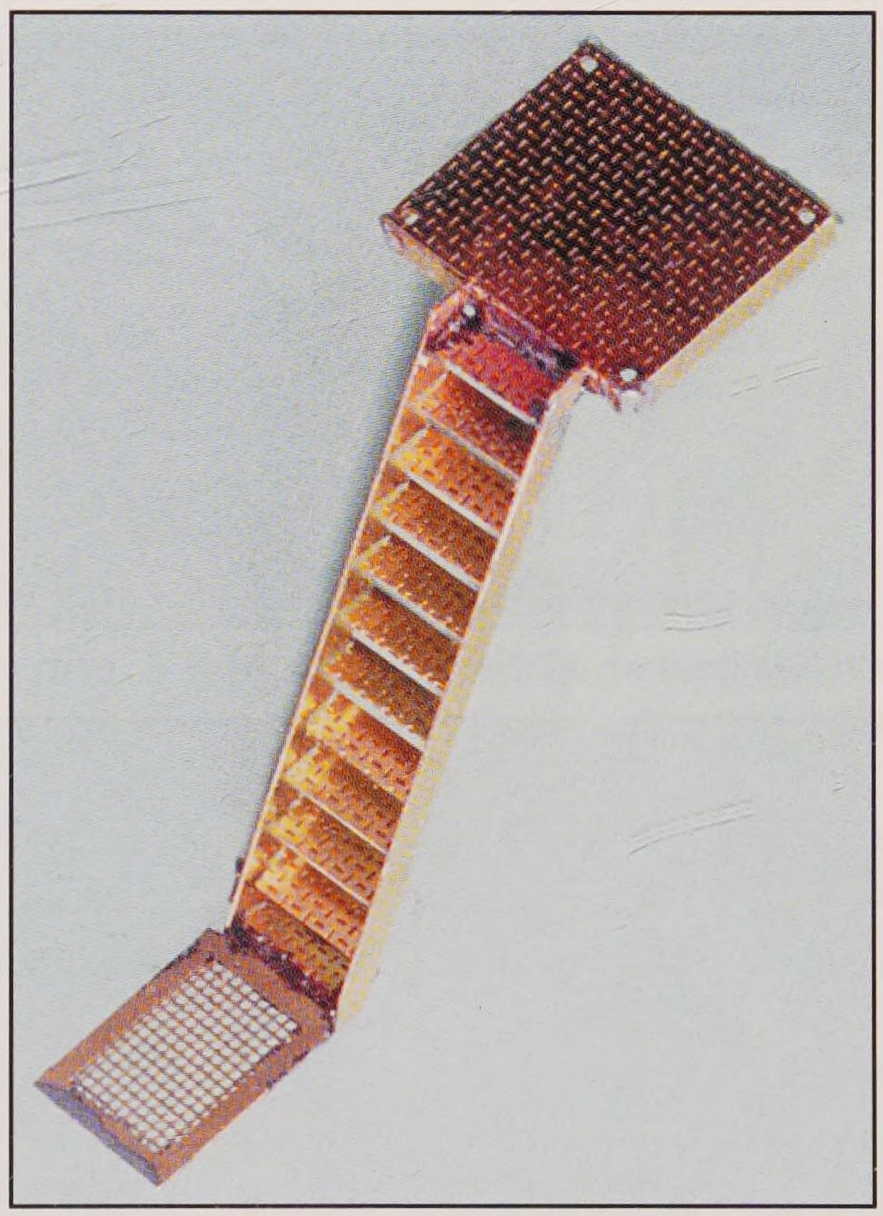


FIG. 15-7: Basic accommodation ladder on *Duilio*.

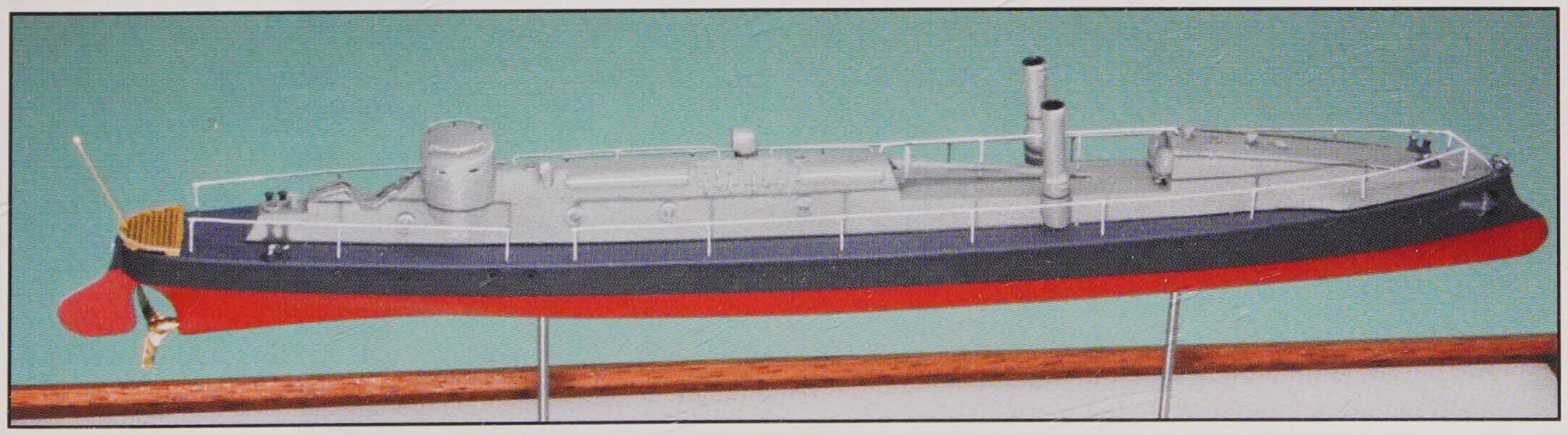


FIG. 9-37: Finished model of *Vespa* at 1:100 scale.

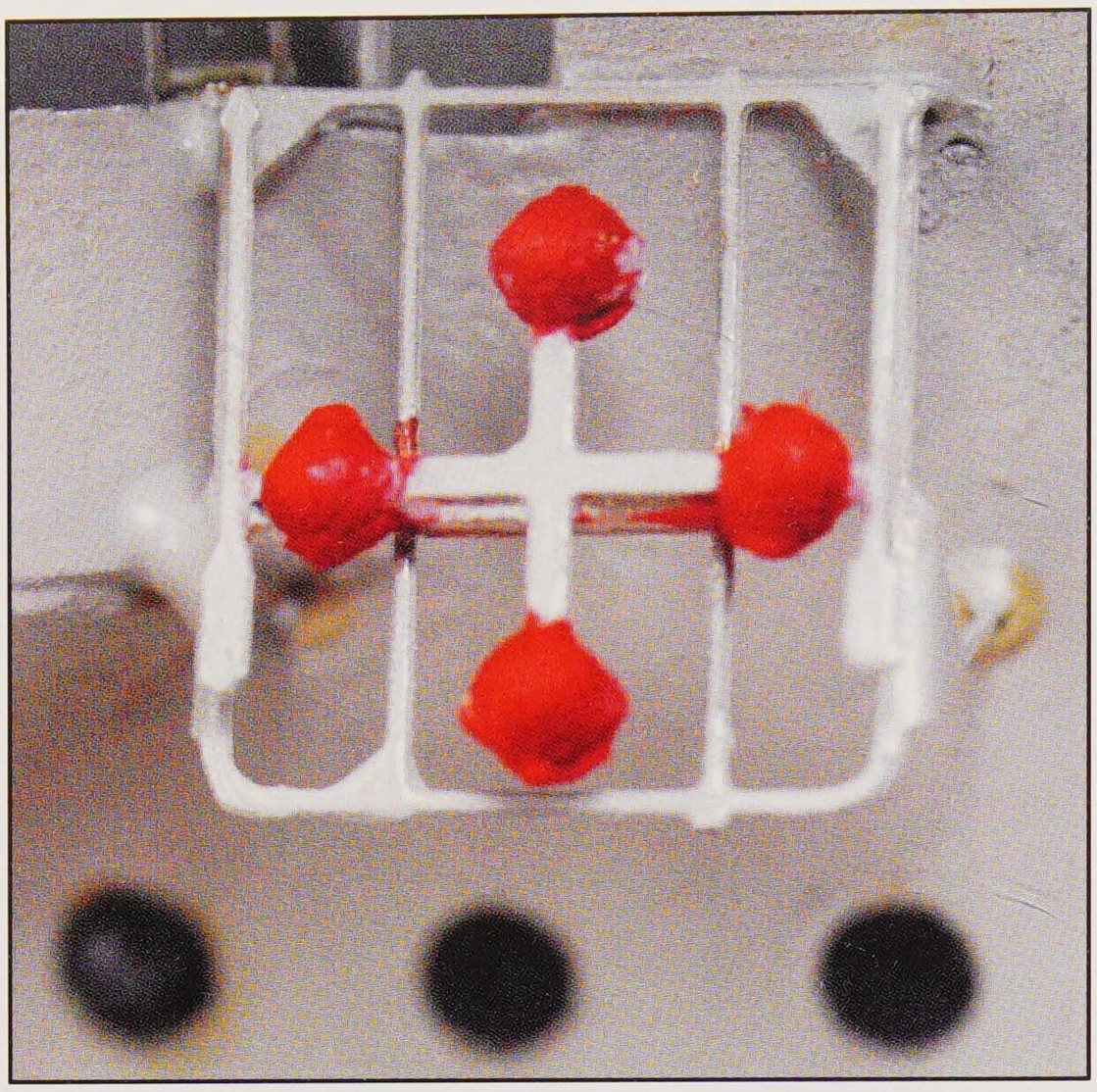


FIG. 15-36: Night life buoy.

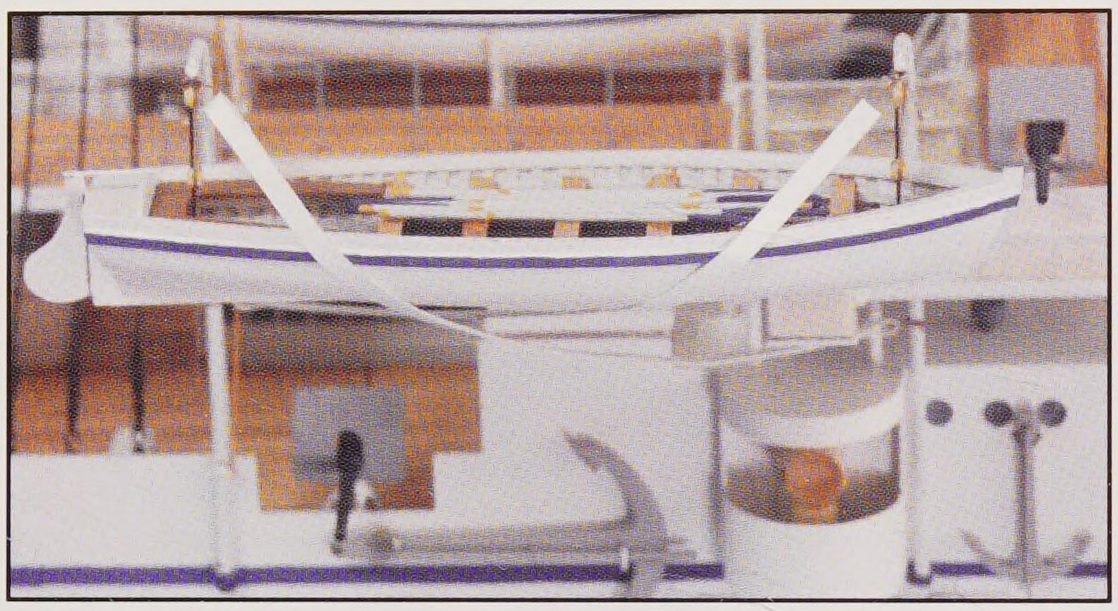


FIG. 9-22: Sea boat on *Victoria*.

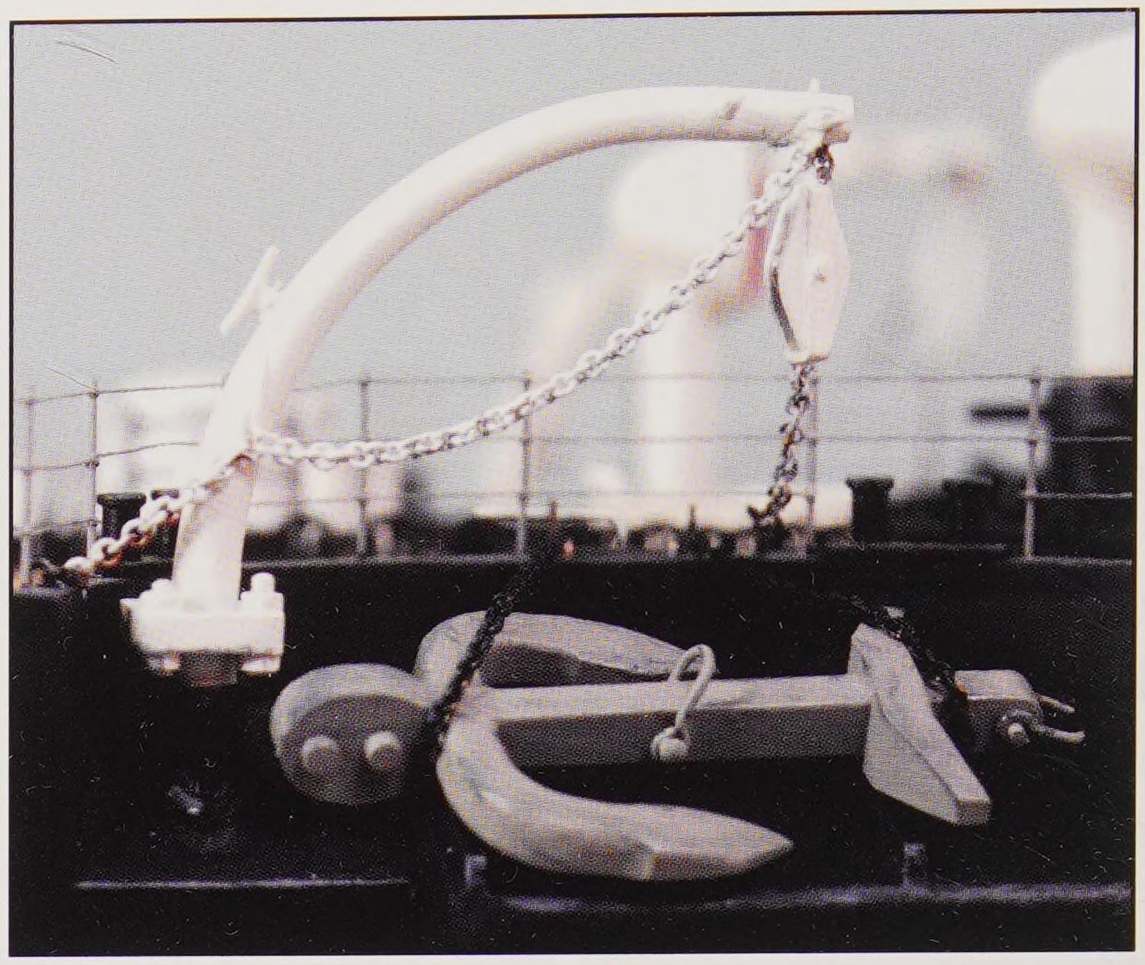
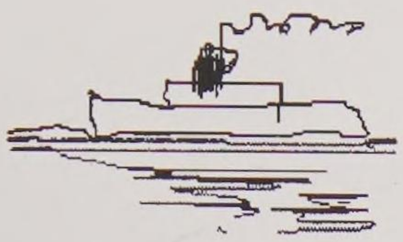


FIG. 11-11: Cat davit on *Victoria*.

FIG. 8-11: Quick-firer on *Empress of India*.

FIG. 6-20: Funnel stays.



Chapter Nine

Ship's Boats

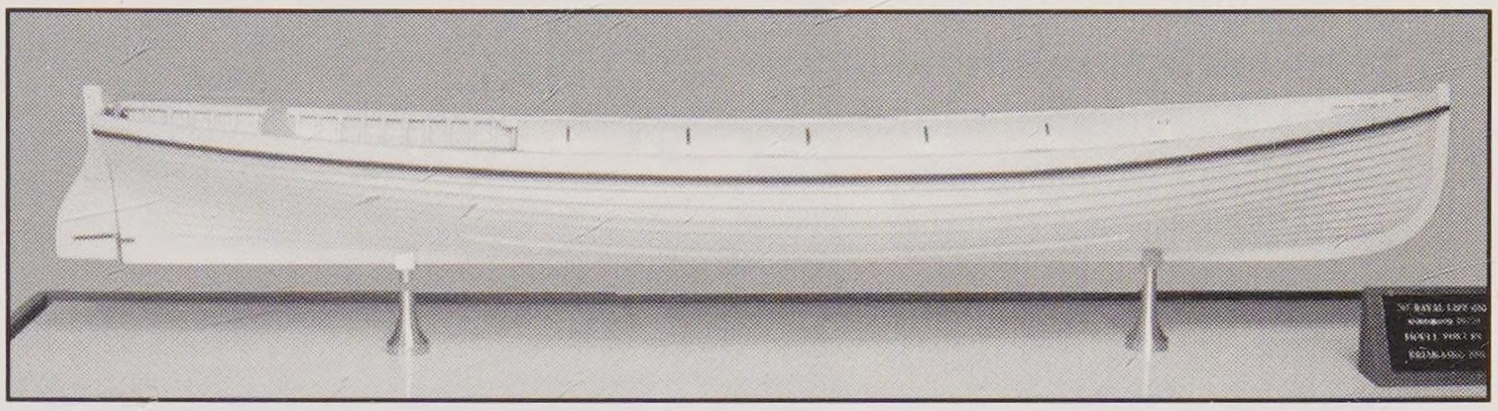


FIG. 9-2: Author's model of a 30-foot naval life gig.

What always strikes me when looking at Victorian warships is the elegance of their ship's boats, particularly the gigs. Most Royal Navy rowing boats were clinker built; only the larger ones were carvel. Any powered boats such as pinnaces were steam driven, the internal combustion engine coming in only after the turn of the century. When you read how much routine care steam boilers and engines required, you can imagine what a relief internal combustion engines must have been.

Fig. 9-1 (c/s) shows a steam launch stowed on *Victoria*. **Figs. 9-2** and **9-3** (c/s) show my model of a 30-foot Naval life gig.

Appendix I of Lieutenant Commander Stapleton's excellent book *Steam Picket Boats* (Terence Dalton, Ltd.) gives the instructions for raising steam, caring for the machinery, cleaning the boiler, etc. They indicate the manpower required to operate steam picket boats. Steam may have been evocative and, dare we say, romantic, but at a great price.

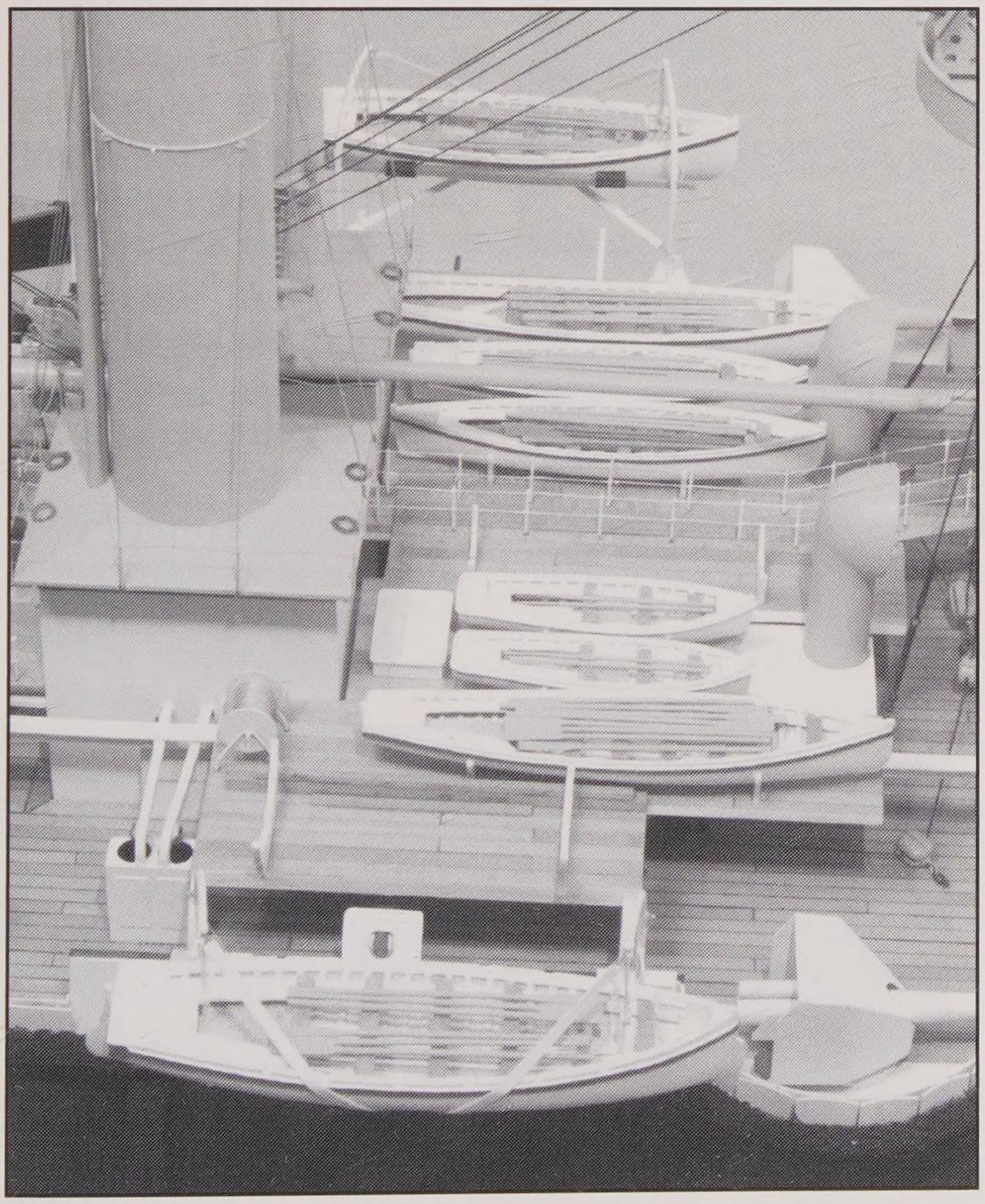


FIG. 9-5: Boats stowed on *Empress of India*.

Victorian ship's boats are similar to modern ship's boats and can be made in the same way. A full description of my methods is detailed in *Advanced Ship Modelling*. **Fig. 9-4** (c/s) shows finished boats stowed on *Duilio*. **Fig. 9-5** shows the boats forward of the funnels. The two cutters on external davits acted as sea boats. The inboard crutches are for when the boats were stowed on deck. **Fig. 9-6** (c/s) shows *Empress of India's* heavier steam-driven boats stowed aft of the funnels. **Fig. 9-7** shows *Victoria's* impressive collection of boats including two sea boats.

Assuming you do not know the difference between clinker (or clencher) and carvel built, clinker is where each plank overlaps outboard of the plank below it. Carvel is where the planks lay edge to edge to give a smooth surface. Carvel double diagonal is where two planking layers are laid at 45° to the keel in opposite directions. An interesting fact is that the copper nails used in clinker building can become "nail sick" and break. Electrochemical action with the sea water acting as an electrolyte "waists" the nails and weakens them.

In the Isles of Scilly which lie 30 miles west of southwest England, gigs were used during the 19th century for putting pilots on channel bound ships. Their use declined with the start of the 20th century, but interest in them has been re-

vived and they are now used for competitive rowing. Some built in the 1820's have been renailed several times due to nail sickness. Their elm structure, however, has remained in excellent condition.

When boats are carvel built, no planking is needed, since individual planks are indiscernible at that scale. Clinker built boats, however, can have paper planks. A computer can derive their shapes (**Fig. 9-8**).

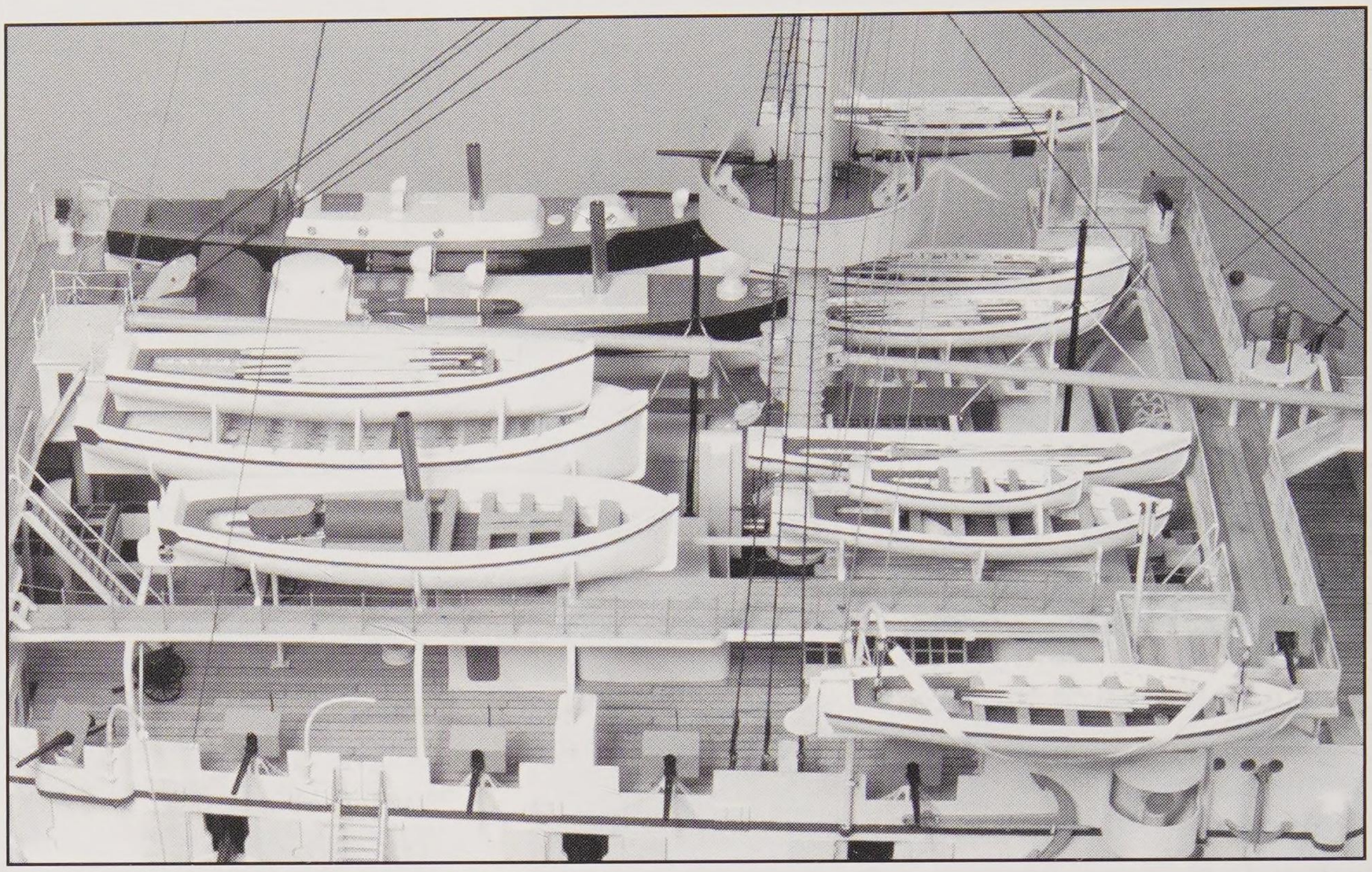


FIG. 9-7: *Victoria's* collection of boats.

Model ship's boats

I originally made ship's boats as woodcarvings – two halves with the keel and stem post fitted between them. *Victoria's* steam launch (**Fig. 9-1**) was fabricated this way. I discontinued the practice, because getting the hulls thin enough to be realistic was too difficult.

The fitting out was done by gluing in an inwale and springing the timbers under it. Since every timber is a different length, this became a tedious and time-consuming occupation. Therefore, it was decided to make the open boats from mouldings. These are usually made from 0.02" polycard and moulded using boiling water, a male plug (**Figs 9-9** and **9-10**), and a female die. Unsure of polycard's longevity, I used acrylonitrile butadiene styrene (ABS) instead.

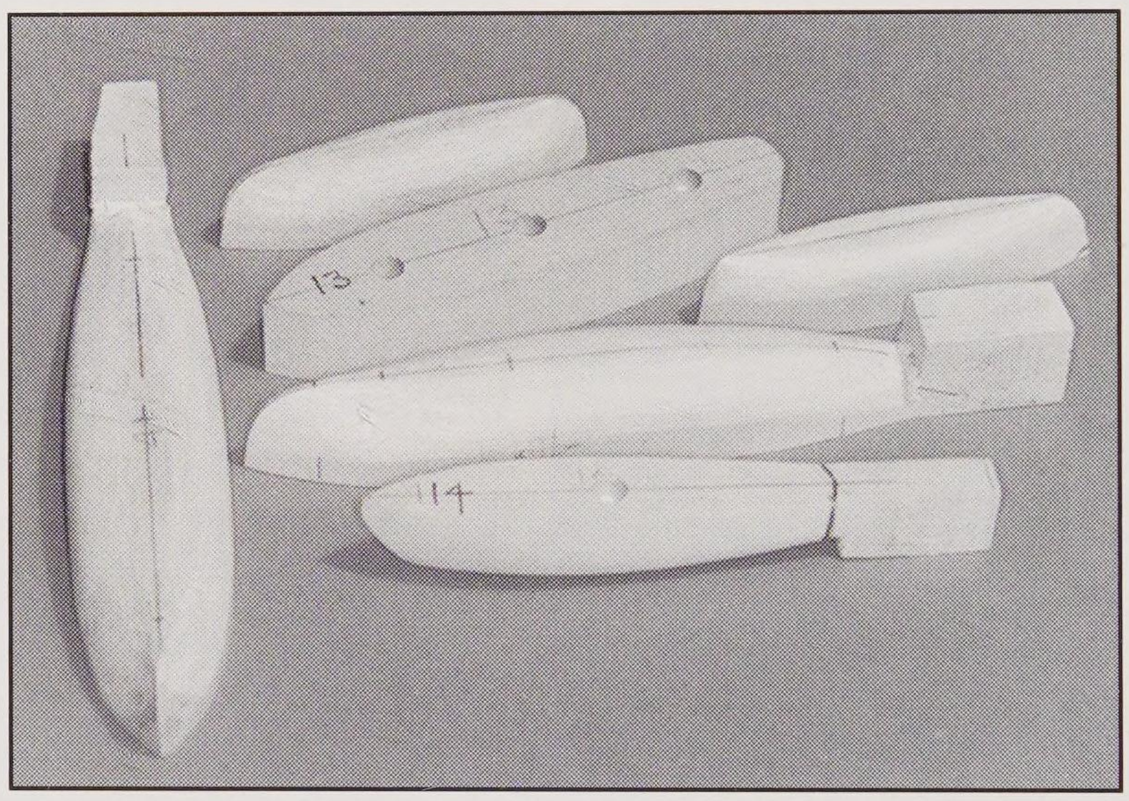


FIG. 9-10: Unpainted plugs in various stages of completion.

Lacking experience with ABS, I adopted the same methods I use with styrene. These worked satisfactorily, except greater

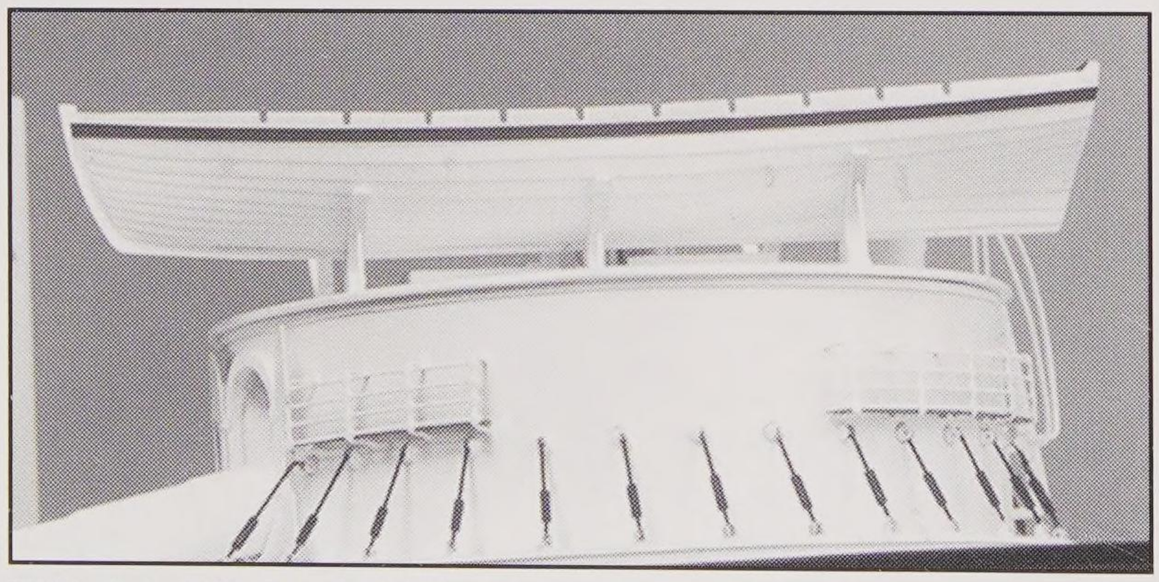


FIG. 9-8: Clinker built boat.

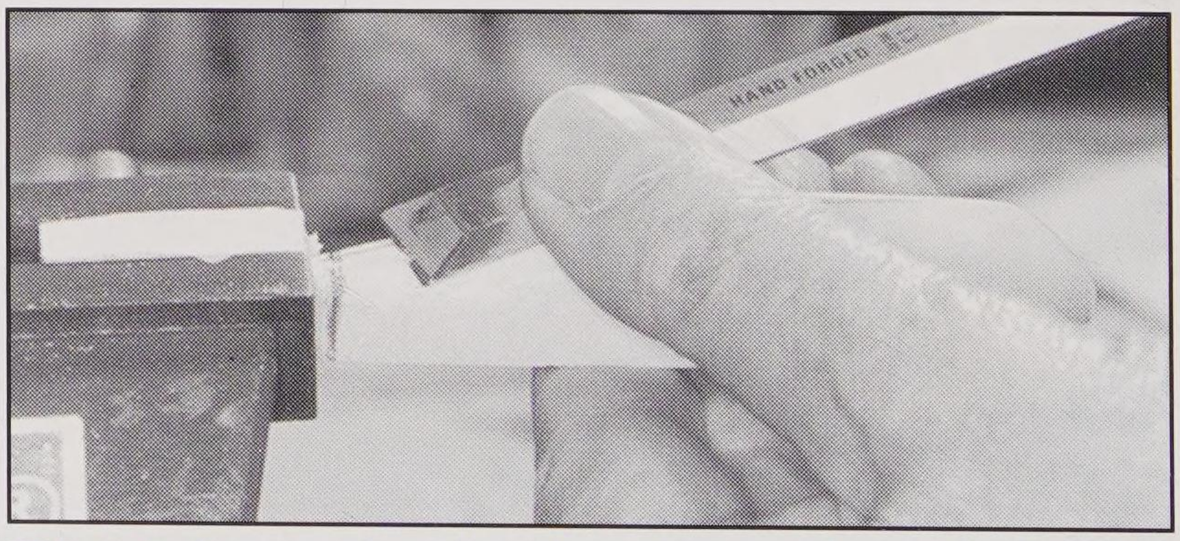


FIG. 9-9: Carving the plug. Note the extra length for holding in the vice.

force was required. Therefore, stronger dies (female part) were necessary; otherwise, they collapsed. (My "boiling water" method is detailed in *Advanced Ship Modelling*.) Others use dry heat to soften the material, but whichever is used, the result is the same. It must be emphasized that boiling water is dangerous, but so is hot plastic. Exercise great care and do not allow children to use these methods unsupervised.

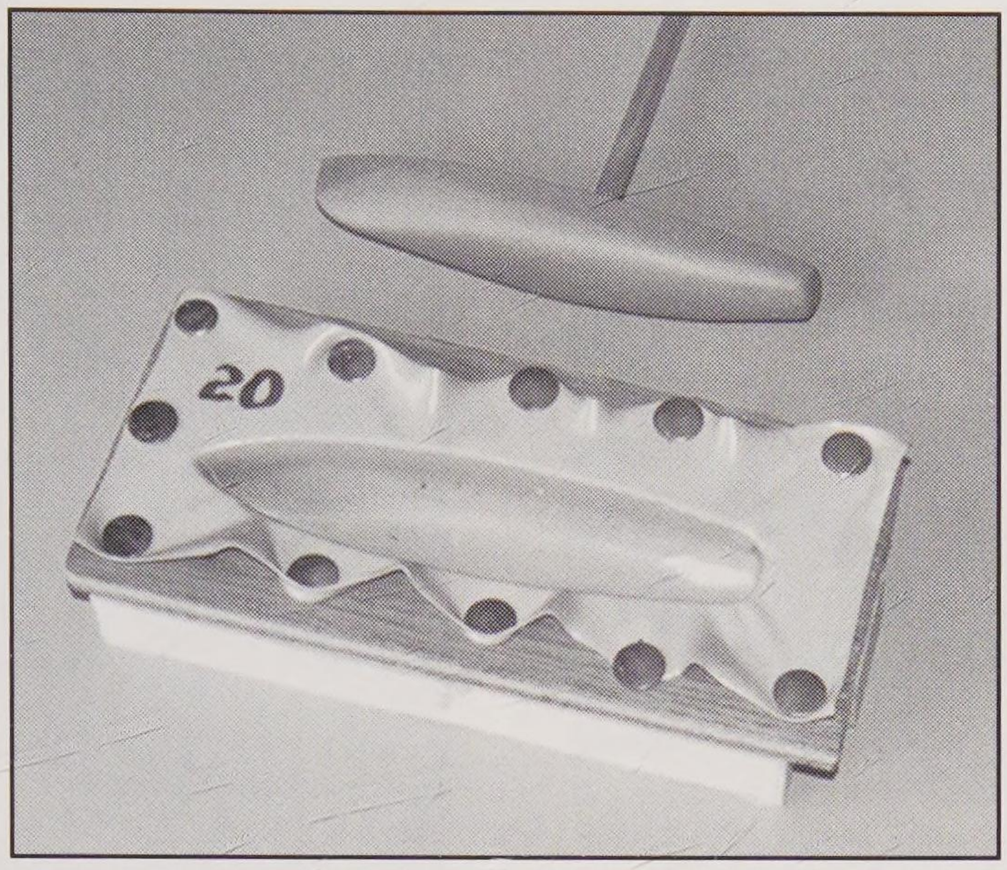


FIG. 9-11: Completed moulding with plug and handling rod. Note the fully supported die.

Points to watch

Make the dies larger than necessary so you can put the drawing pins well away from the die edges. This allows adequate material to flow into the die aperture. Always use plenty of pins to avoid "drag in" and, hence, possible crinkles in the moulding. In other words, make sure the material stretches evenly into the mould aperture to produce a wrinkle-free moulding surrounded by a flat flange. **Fig. 9-11** shows a completed moulding. However, more drawing pins would have produced a flatter flange.

Also ensure that adequate clearance exists between the plug and die. Remember, the dry clearance reduces as the wood swells in water. If the dies are made from plywood, make sure it is WBP quality (BS1088 grade). This will withstand boiling water. Marine ply is usually WBP quality and, therefore, okay.

Make sure the die is thick enough to make a full depth draw; otherwise, you end up trying to push the moulding through the surface on which the die is resting (saucepan bottom or whatever). Also, support the die properly, or the extra pressure needed when using ABS may collapse it (**Fig. 9-11**). Modeling large boats in ABS may require some mechanical help. **Fig. 9-12** shows two G-clamps pushing the plug into the die.

Do not mould in the transom if modelling square transom boats, as this will give you a "sucked sweet" result. Make the moulding longer and radiused at the aft end (**Fig. 9-13**). That makes it easier to mould and reduces thinning of the moulding. The separate transom can be glued in afterward and the radiused part cut off, producing a transom with sharp corners.

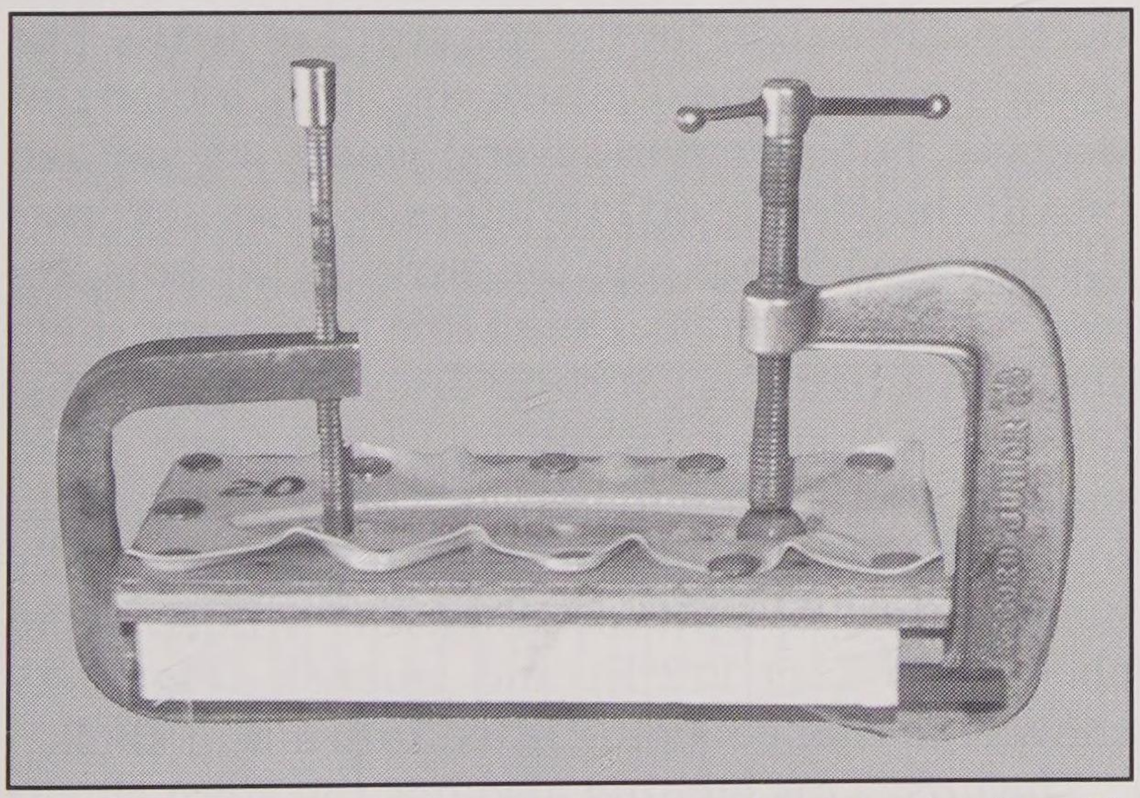


FIG. 9-12: When using ABS, push the plug into the die with two G-clamps.

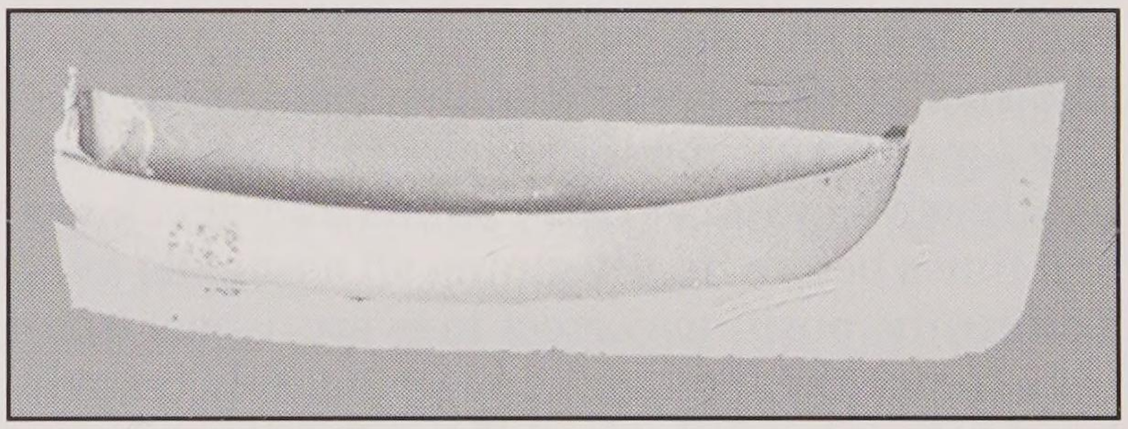


FIG. 9-13: Moulding with keel and false transom fitted.

Thinning will usually occur at the forefoot and cannot be avoided. Hold the plug to the light to see the amount. David's P38 polyester car filler (Isopon) can be used to reinforce an ABS shell, and it will adhere satisfactorily. It does not stick well to styrene, so use Milliput (two-part epoxy filler) instead. Reinforcing can be done before or after fitting the oversized keel. When done before, cut down the plug to accommodate the transom and forefoot reinforcing.

Firstly, trim some of the excess plastic, leaving a small flange around the top for strength. However, cut off the flange completely at the bow, as

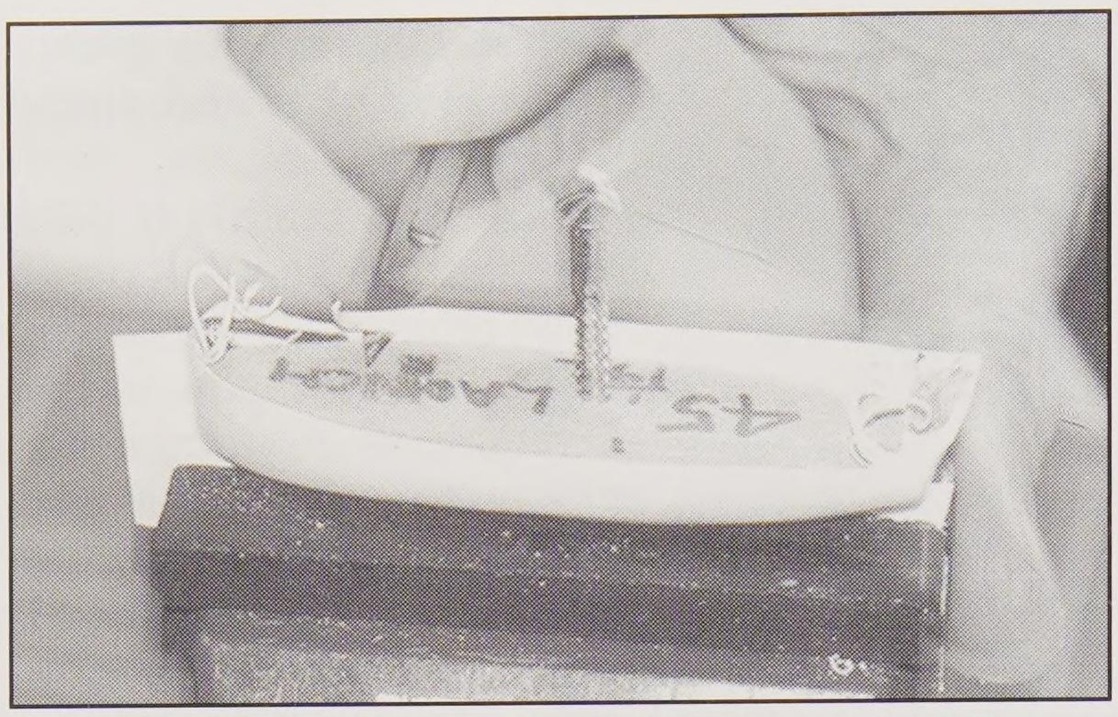


FIG. 9-14: Cutting the moulding to the correct sheer line using the modified plug as a template.

the keel extension (stem) finishes above the bow. Otherwise, with the flange in position at that point, it cannot be done.

Cut a thin card template to fit the hull and bow profiles. Get it right before cutting it out of 0.02" thick plastic sheet. If possible, keep the hull and keel material the same. The keel on a double-ended boat such as a whaler must fit all round, but the keel can run out at the stern on transom boats, making the job simpler.

Fixing the keel centrally on the hull is not easy – at least I find it so. The way I tackle it is to mount the plug via its handling rod upside down in a vice. Then I slip the hull moulding onto the plug. The keel piece is positioned using strips of adhesive tape, Plasticene, or whatever. Tack the keel lightly with cyano at three points and check several times before finally gluing all along the joint. Getting the position correct in every aspect is not easy, hence the light tacking. Do not rely on a debonder to release the keel if you get it wrong, as some attack ABS. Use mechanical means to separate them instead.

Once the keel is attached, use it to hold the moulding right way up in the vice while cutting the shell to its correct sheer (**Fig. 9-14**). You can mark out the moulding and cut down to the line with a sharp scalpel, but I have a better way. Cut the top of the plug to its correct shape first, place it back into the moulding and, with the former supporting the latter, cut down to the top surface. When cutting near the bow – and sometimes the stern – make sure you do not cut off the stem post (part of your keel), as this usually stands proud of the hull's sheer line. Before proceeding, check that you have cut the sides to their correct height.

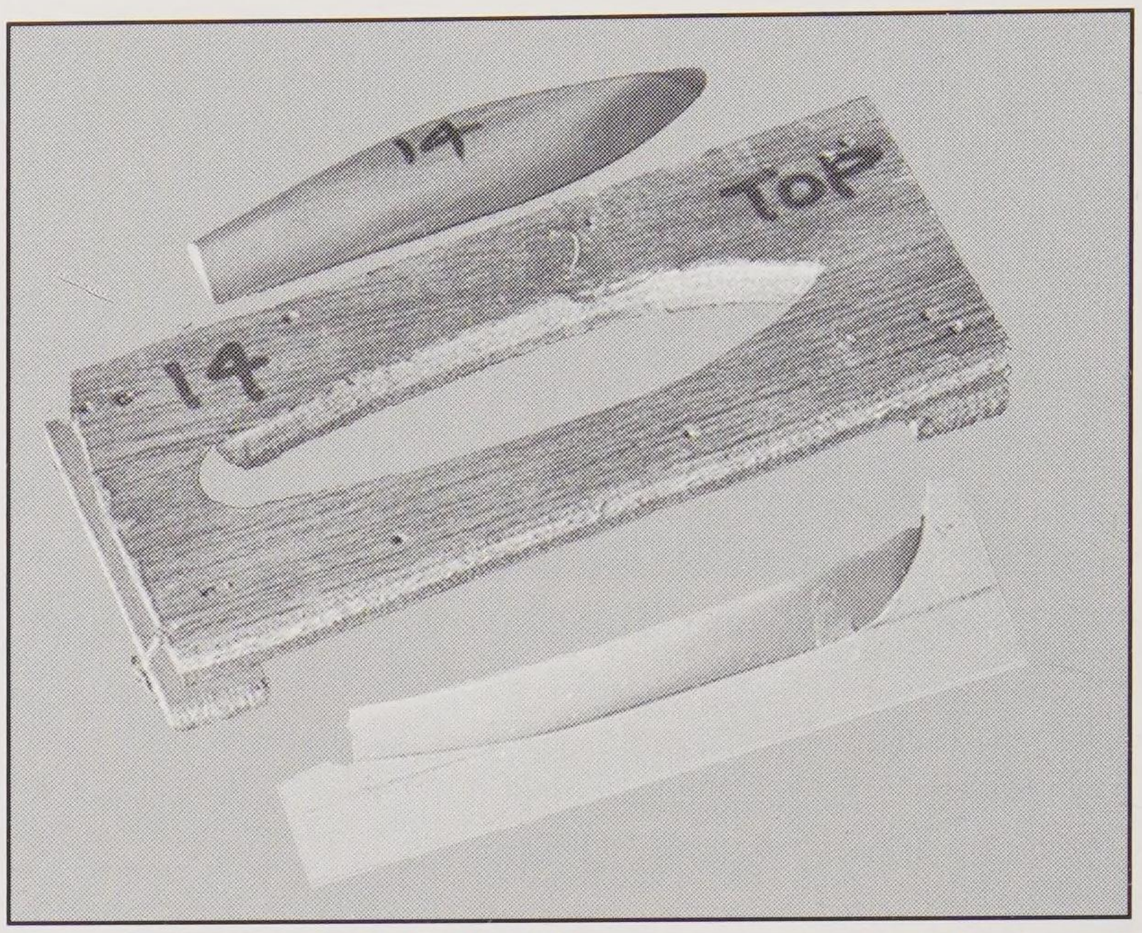


FIG. 9-15: Moulded shell with separate transom, keel, and die. Plug has been cut back so the transom can be fitted.

It is too easy to end up with boats that are too "tall."

Fig. 9-15 shows a plug cut back so the transom can be fitted, the unaltered die with a round transom end, and the shell fitted with a transom and keel (including the stem post).

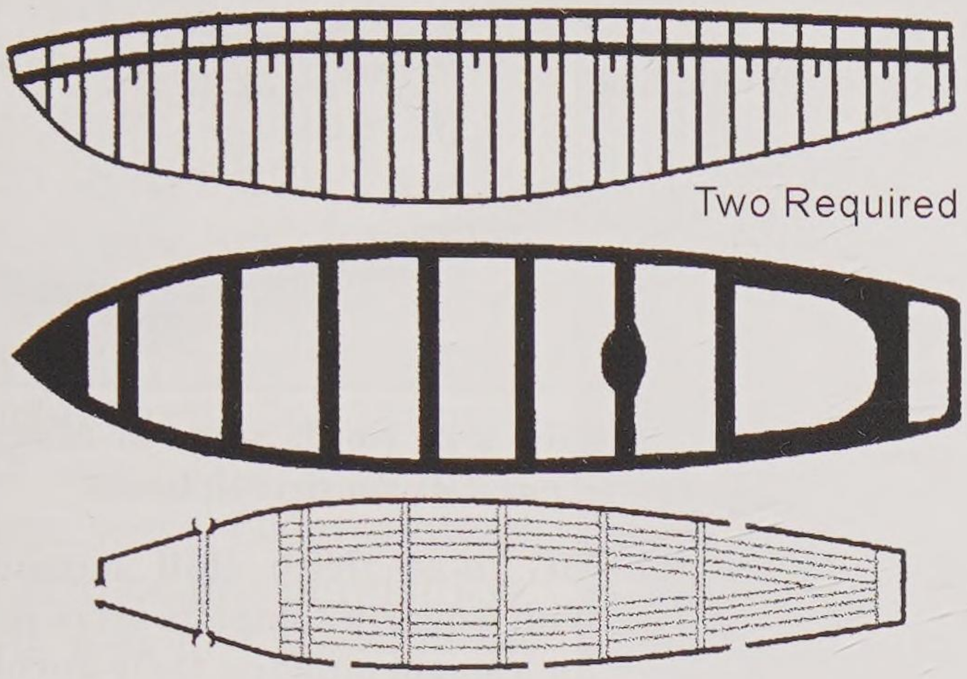
Fitting out

When I first started fitting out the interior of ship's boats with etchings, I used their drawings as templates, but always ended up with the pieces too large. This was due to the hull's vertical curvature. The best way is to cut cardboard templates that can be fitted to the actual moulding, then use these to make the etching drawings. You normally require the following:

Timbers (ribs) two off: These have an inwale at the top and a shelf for the thwarts (**Fig. 9-16**). The lower ends of the timbers are also joined for strength, but are cut in several places when fitted into the hull (more on this later). You cannot dress the timber etchings into the curve of the boat unless you anneal them. Doing this by waving them about in a flame is courting disaster, as they distort badly. Instead, tightly fold up a piece of tin plate or similar thin metal, then drop in the etching. This protects it from air and oxidation while maintaining its flatness. Heat the whole lot to about 600°C (1,112°F) and quench. **Fig. 9-17** shows the timbers being fitted into a hull shell.

Thwarts: This etching also has the stern sheets and, if required, a piece of decking at the bow. These are linked with a false shelf around the

FIG. 9-16 – ETCHING DRAWINGS FOR BOAT TIMBERS, THWARTS, AND FOOTBOARDS



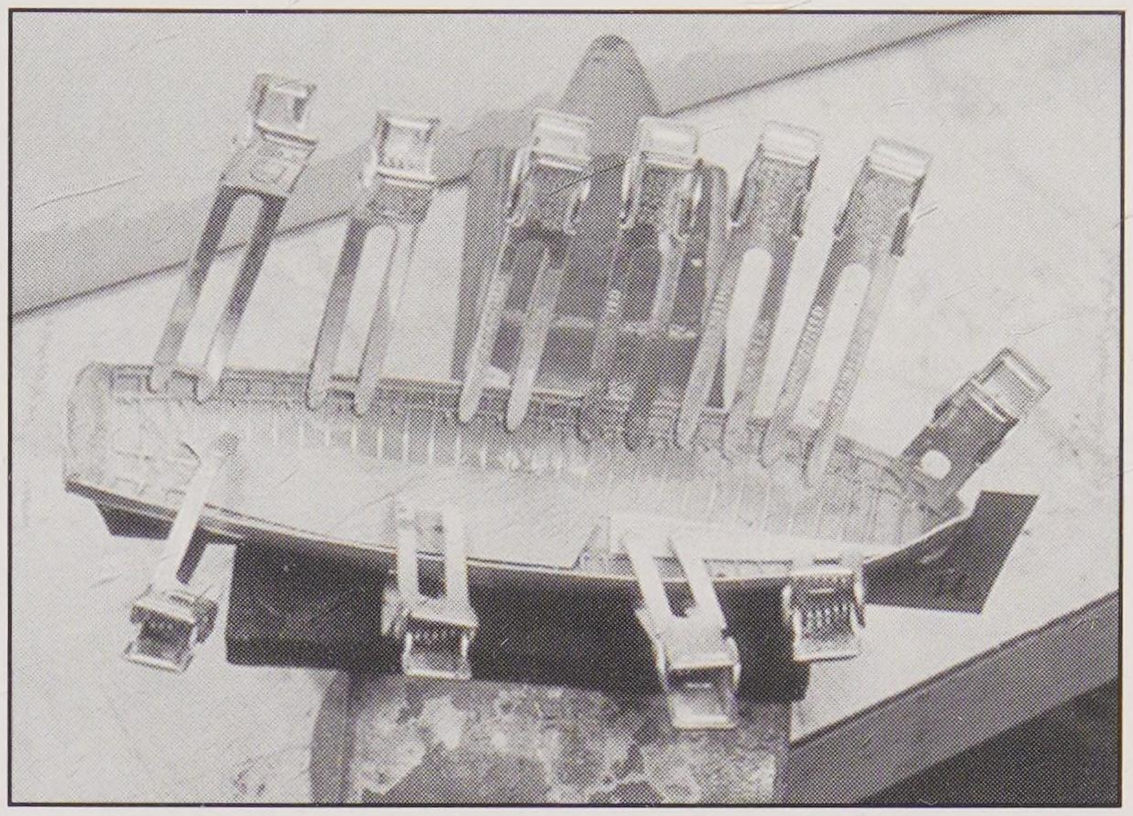


FIG. 9-17: Fitting the inwale and timbers to a boat shell.

edge. All very naughty, but you end up with just one piece to simply drop in (refer to chapter five).

Footboards: These sit over the lower edge of the timber etchings. They effectively cover up any snipping you do while dressing the timbers' lower edges into the curve of the boat. Half etching can simulate the planking comprising the footboards (**Fig. 9-16**).

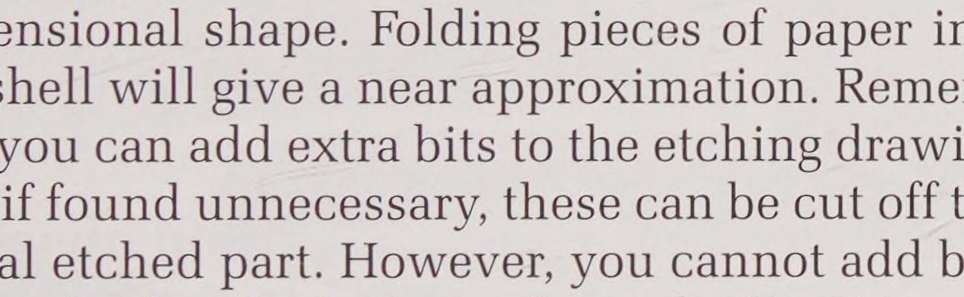
No matter how carefully you design the etching drawing it will be a compromise, because it is a two-dimensional design fitting into a three-dimensional shape. Folding pieces of paper into the shell will give a near approximation. Remember, you can add extra bits to the etching drawing but, if found unnecessary, these can be cut off the actual etched part. However, you cannot add bits to the final etched piece of metal. 3D CAD and lofting programmes may help, but I am still experimenting with these.

After annealing the rib etching, cut the lower connecting line (**Fig. 9-18**). This removes excess material as you dress the etching into the shell's interior. Preform the curves with your fingers, around the plug, or into the shell. Check whether the inwale on the original lies against or below the sheer's top edge. Some ship's boats have oar slots in the sheer and the inwale lies below them. If it did not, the slots would cut into the inwale and remove its strength. The secret is to get the inwale, wherever its position, to conform as closely as possibly to the curve of the sheer without stress. You may have to cut the shelf in one or two places. If so, these cuts must line up with any on the lower edge so the etching can bend "edge-wise." It sounds complicated, but the procedure is obvious when you are doing it.

Clip the etching (**Fig. 9-18**) and secure with cyano. Do this very carefully, as some debonder will attack ABS. I am not sure if polystyrene is similarly affected.

Once the port and starboard ribs are attached, fit the footboards and any gratings. A large gap exists under the footboards, so use a gap filler such as Isopon for the adhesive. When everything is in-

FIG. 9-18
CUTTING RIB ETCHING



Arrows Suggest Where To Cut The Connecting Points

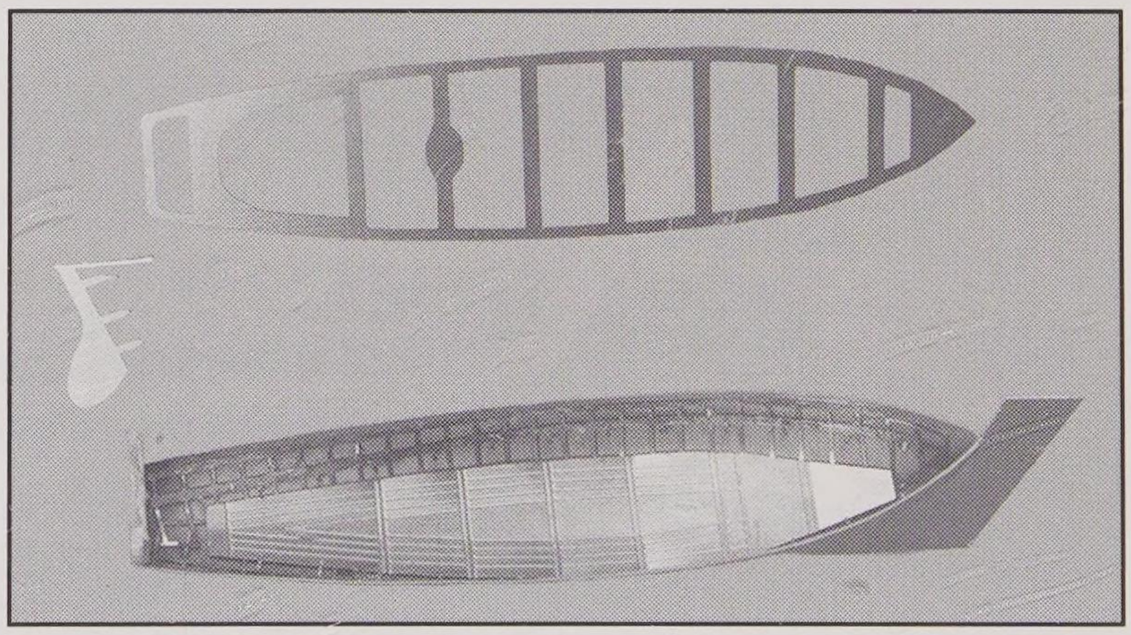
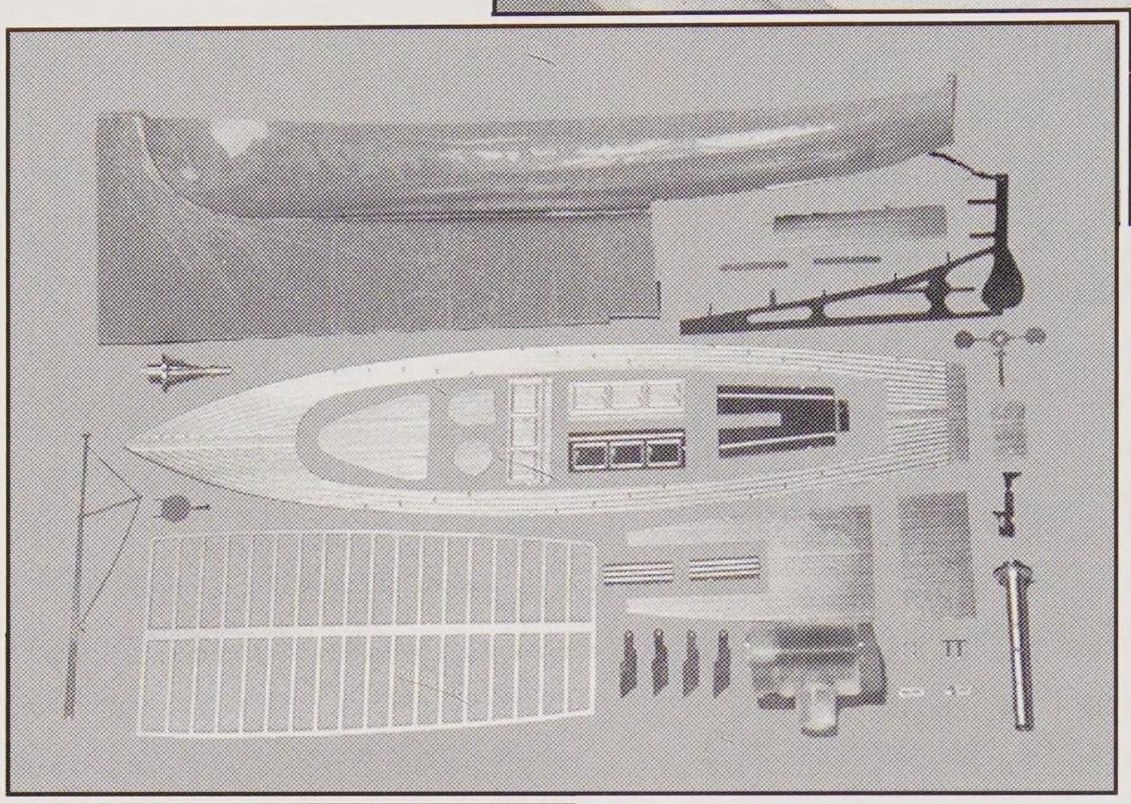


FIG. 9-19: Boat complete except for etched thwarts and rudder.

stalled below the shelf (which runs around the interior below the inwale and supports the thwarts), attach the thwart etching (**Fig. 9-19**).

Rudder and tiller: It is usual practice, in the Royal Navy at least, to unship the rudder and lay it in the stern sheets of any stowed boat. This prevents the rudder from swinging about. **Fig. 9-20** shows the rudder stowed thus on one of *Duilio's* ship's boats. **Fig. 9-21** are rudders ready for spraying.



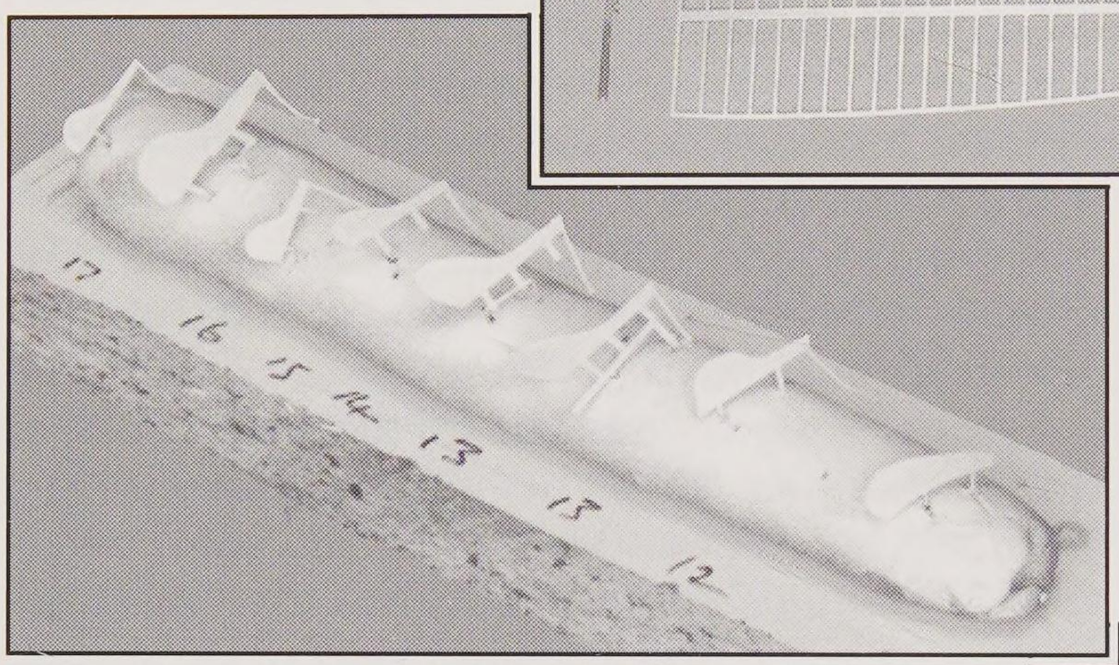


FIG. 9-21: Etched rudders for *Duilio's* ship's boats pushed into a strip of Plasticene for spraying.

Fig. 9-22 shows *Victoria's* sea boat, held by two canvas straps against the riving spar to prevent it from swinging about. Notice that the rudder is shipped. The boat's blue stripe just under the gunwale matches a similar stripe along *Victoria's* hull. Victorian captains had quite an amount of leeway when painting their vessels.

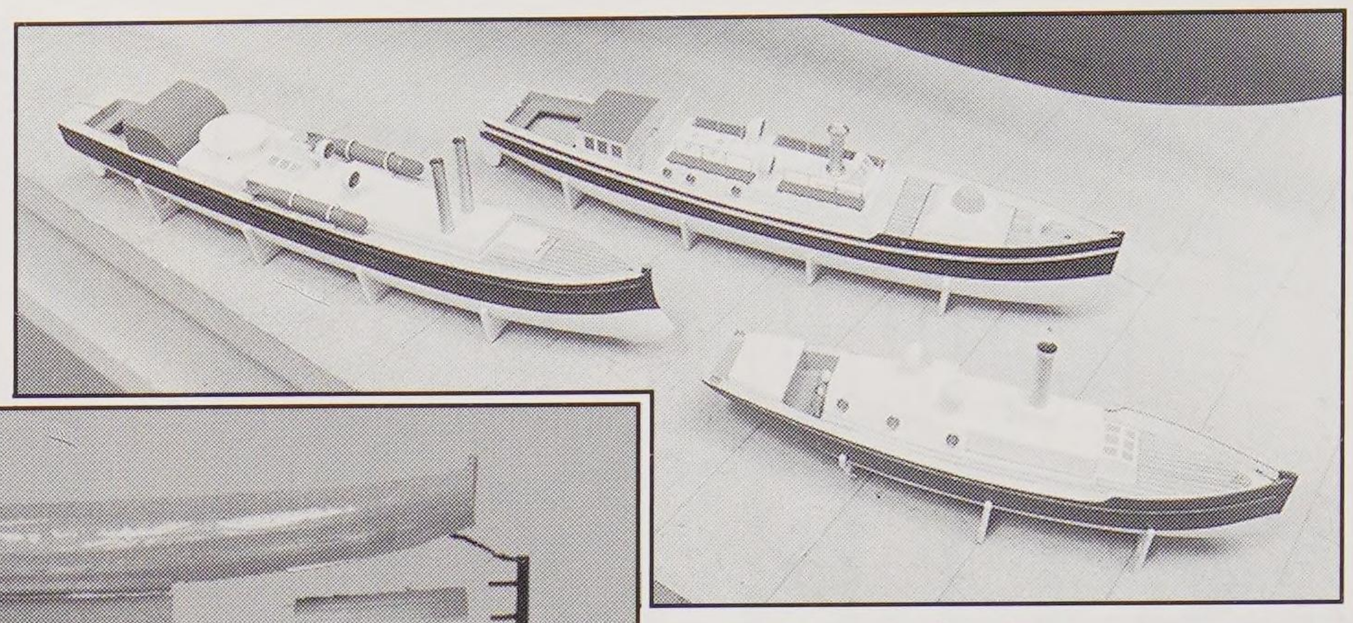
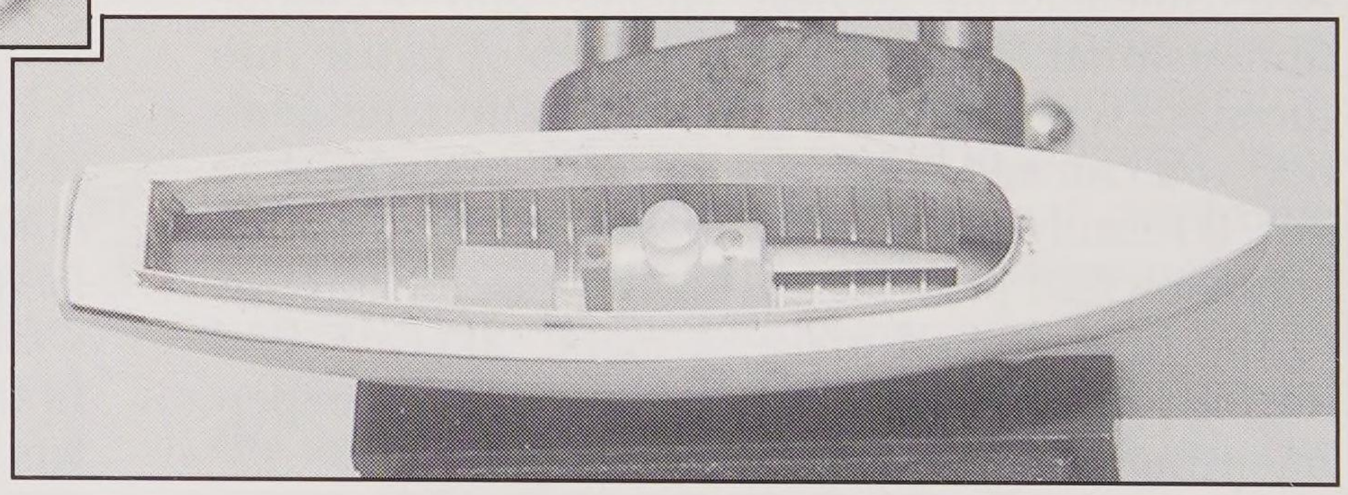


FIG. 9-23 (top): Some of *Magnificent's* steam-driven boats.

FIG. 9-24 (left): Hull moulding with a nearly complete set of parts for a steam pinnace. Only the boiler, funnel, and gun mount are turnings.

Steam launches (picket boats): **Fig. 9-23** shows three of *Magnificent's* 50-foot steam-driven boats. *Duilio's* steam launch had a different design. Its parts are shown in **Fig. 9-24**. The boat is largely assembled in **Fig. 9-25**.



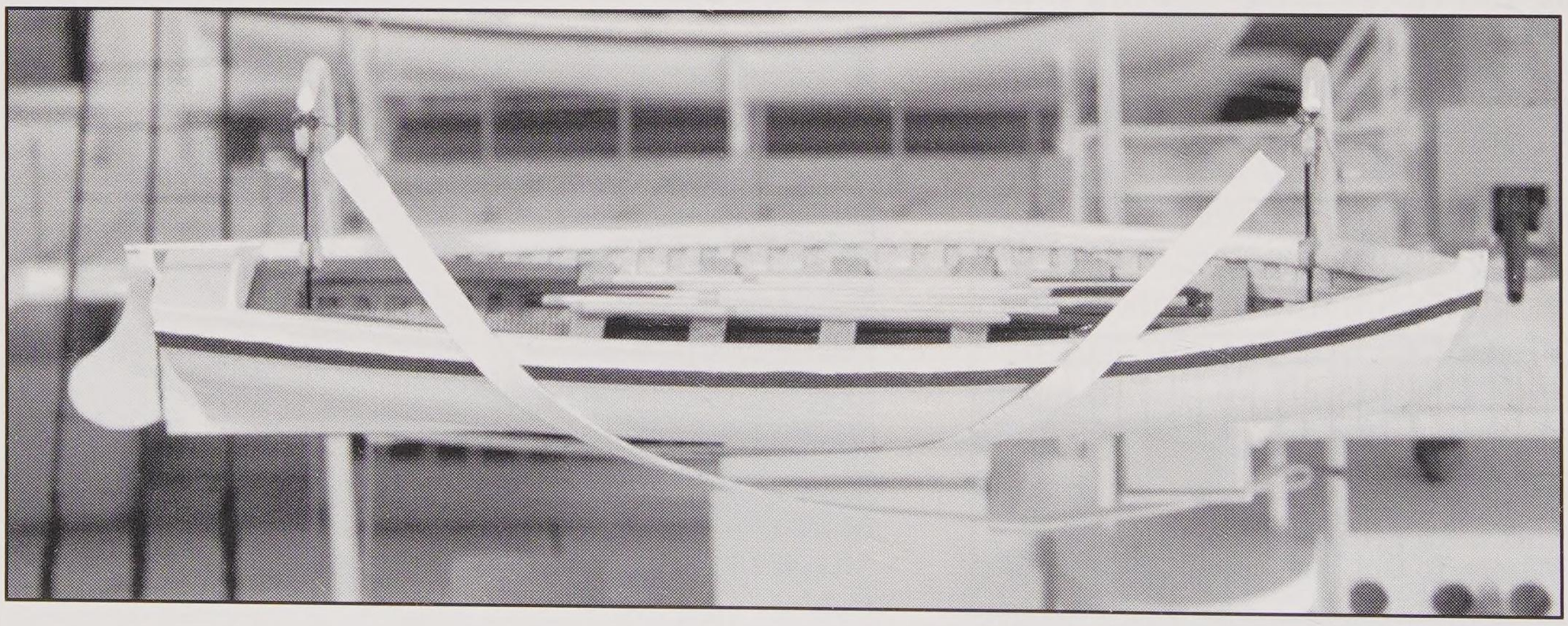


FIG. 9-22 (left): Sea boat on *Victoria*.

FIG. 9-25 (above): Partially assembled steam pinnace with keel not cut to size.

Boat stowage

Victorian ships stowed a large suite of ship's boats for carrying out land operations such as preventing slave trading (**Figs. 9-26** and **9-27**). Normal naval practice on some ships was to sling either cutters or whalers on outboard davits for immediate use. The remaining boats were often stowed on skid beams amidships. This was not possible on *Inflexible* and *Duilio*, as twin turrets occupied their waists. Consequently, *Duilio's* boats were hung on davits fitted to the aft deckhouse. **Fig. 9-28** shows the boats offered up to their davits mainly to determine the position of the riving spars. They supported the boats and stopped them from swinging. As can be seen, only the two packing pieces on the spars actually touched the boats. *Inflexible's* ship's boats were stowed in crutches on top of the aft superstructure. **Figs. 9-30** and **9-31** show *Magnificent's* ship's boats on skid beams.

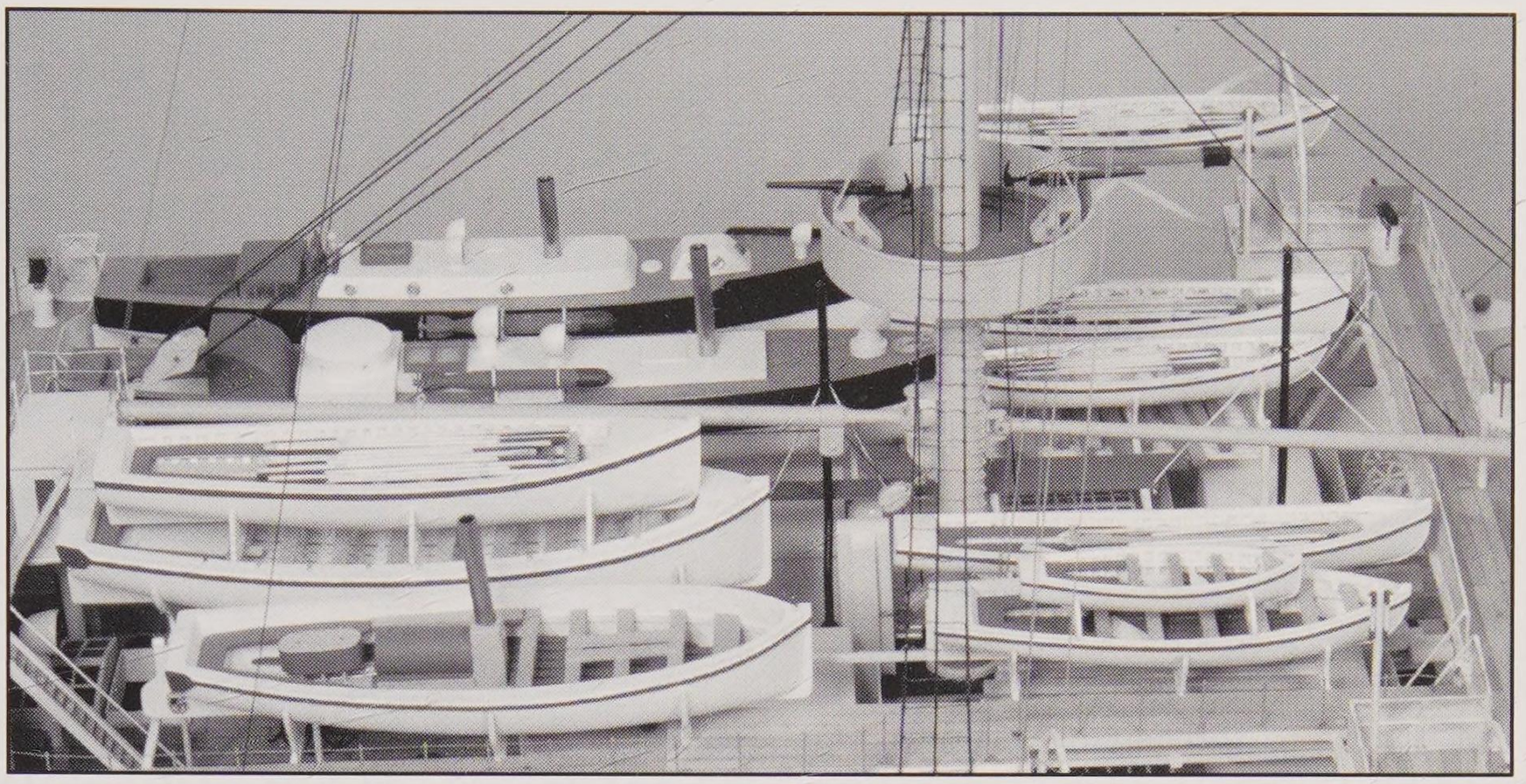


FIG. 9-26: *Victoria's* boat deck.

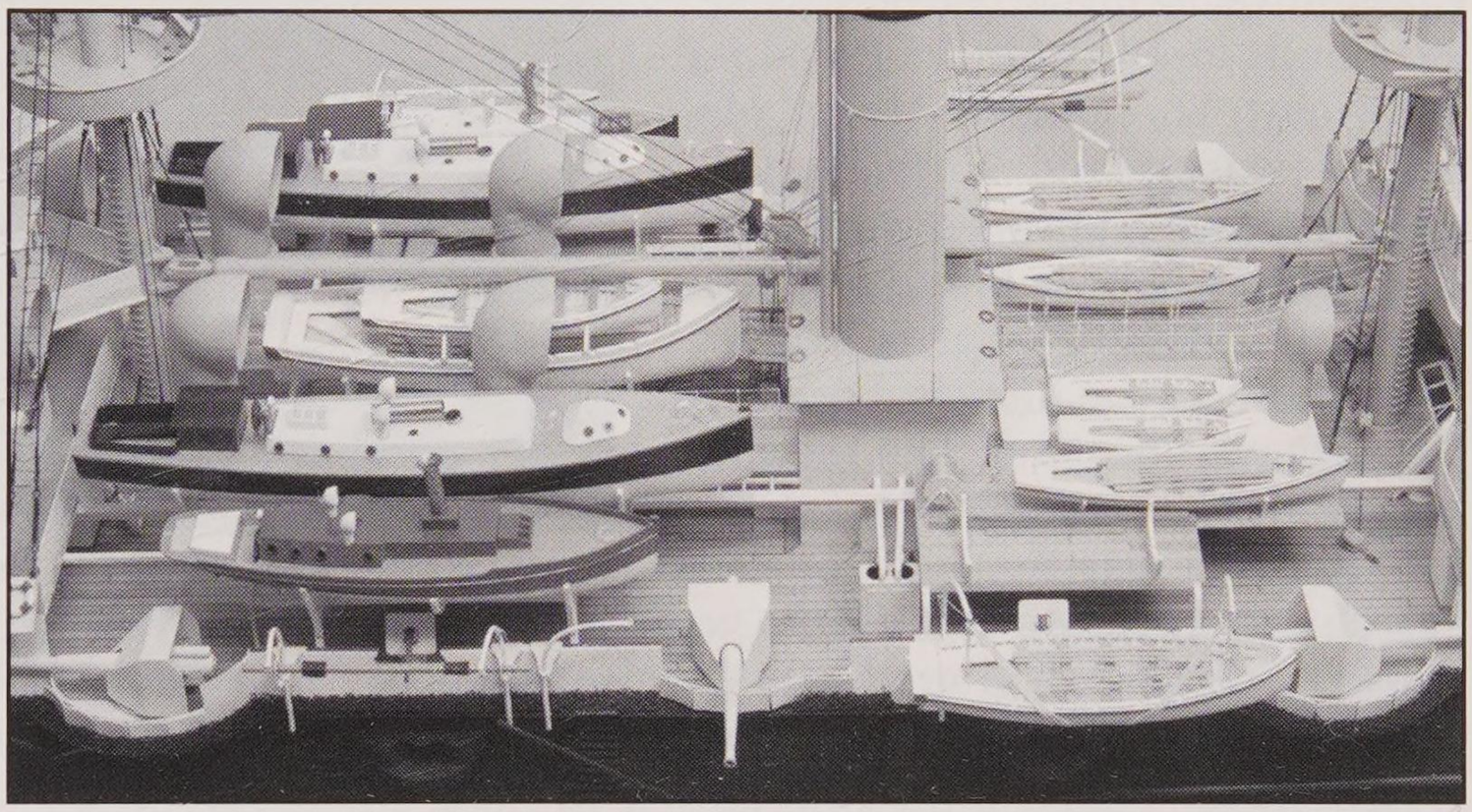


FIG. 9-27: *Empress of India's* boat decks.

Torpedo boat Thornycroft No.175

One feature on *Duilio* and her sister ship *Dandolo* was the internal dock housing a floating torpedo boat. It was launched through the clam opening doors at the stern. Floating torpedo boats evidently were not a great success, as subsequent classes did not carry them. At the time, however, they were feared universally and most navies built them, often in great numbers.

It was decided to examine the possibility of building one of *Duilio's* torpedo boats, either *Nibbio* (British, built by Thornycroft) or *Clio* (Italian, built by Orlando). Research unearthed *Nibbio's* plans in the Thornycroft collection at the National Maritime Museum, but unfortunately they showed

FIG. 9-28: Boats offered up on deckhouse davits.

her as initially equipped with twin spar torpedoes. We know she was delivered to the Italians equipped with twin 14-inch torpedo tubes, but could find no drawings of this configuration.

Further research into the Italian part of the story produced a letter from Dr. Paolo Castignoli, director of the State Archive, saying that no drawings of *Clio* (yard No. 20) existed, and that the archive had all the drawings from the yard.

We returned to the Thornycroft collection to look at later boats carried by *Duilio*. Further searches unearthed drawings of four Second Class torpedo boats (yard Nos. 173-176) built in 1883 for the Royal Italian Navy. These were *Mosca, Ape, Vespa* (wasp), and *Farfalla* (1882-1883). We were sure we were on the right lines when we found a contemporary (1881) lithograph in *Nomini e Navi* showing the identical profile of the discovered plans. The measurements also coincided. It was a fair bet that this was the right one. Research also revealed that *Duilio* was subsequently much altered, which was the fate of many continental battleships then, particularly French ones.

FIG. 9-30: *Magnificent's* boats on their skid beams

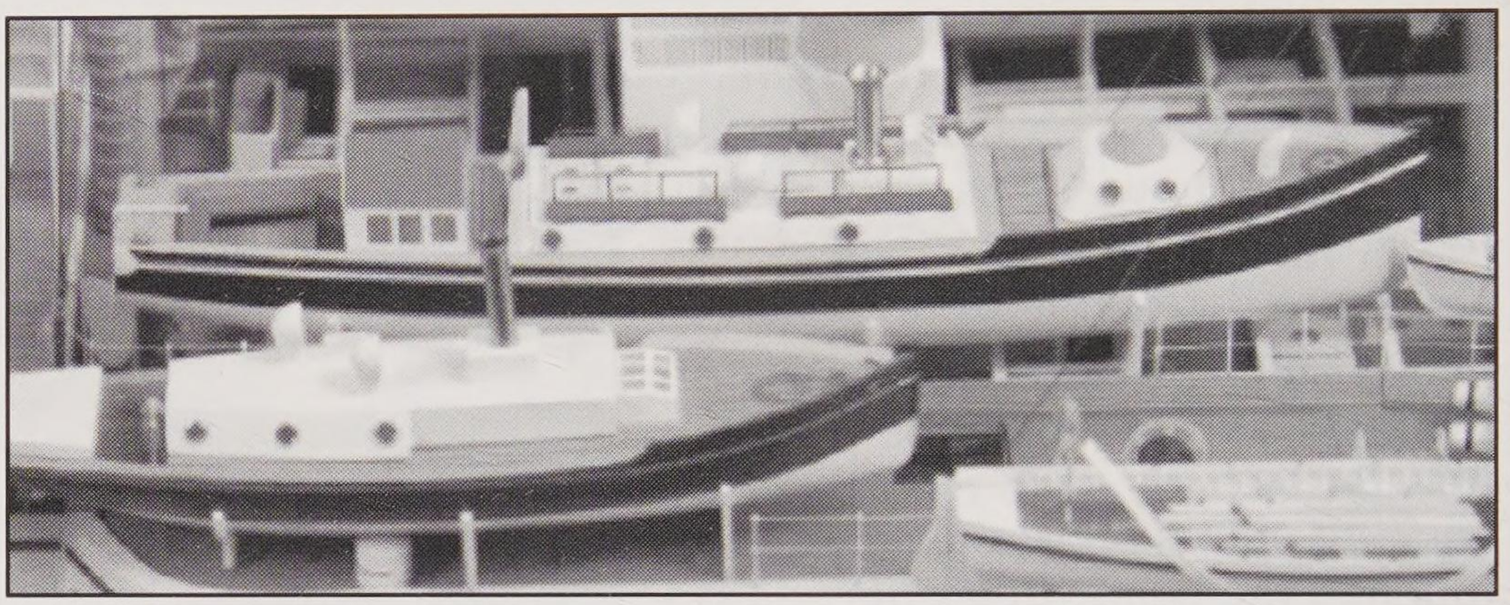


FIG. 9-31: Two of *Magnificent's* steam launches stowed on her boat deck.

I decided to build a model of No.175, *Vespa*, to *Duilio's* 1:100 scale. Plans from the NMM showed the sheer and plan, but no sections. To make a satisfactory hull really requires a set of half-sections. Studying pictures of torpedo boats gave me some idea as to the run of the hull, and I constructed about six sections. All this could have been done by eye, but having cross-section templates ensures both hull halves are the same! Always a good idea. **Fig. 9-32** shows the carved hull.

The superstructure required the same treatment. Both parts were carved in jelutong. The main difficulty was boring the torpedo tube holes. These were angled to come out below the deck edge near the bows. With hindsight, it would have been more accurate to machine these on a milling machine while the hull was still a rectangular, uncarved block of wood. **Fig. 9-33** shows the carved hull and superstructure.

The drawings showed special temporary stands with sloping curved troughs (at the same angle as

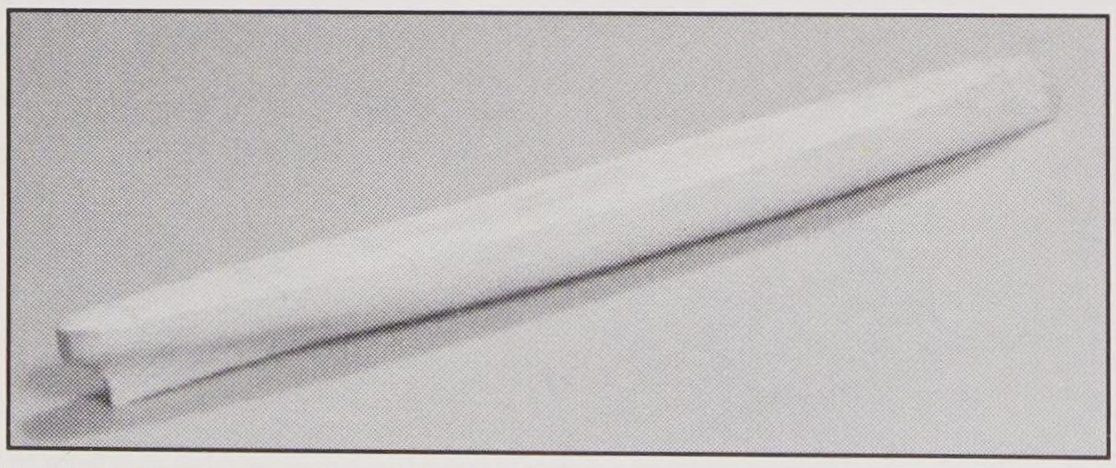


FIG. 9-32: Carved hull of *RN Vespa*.

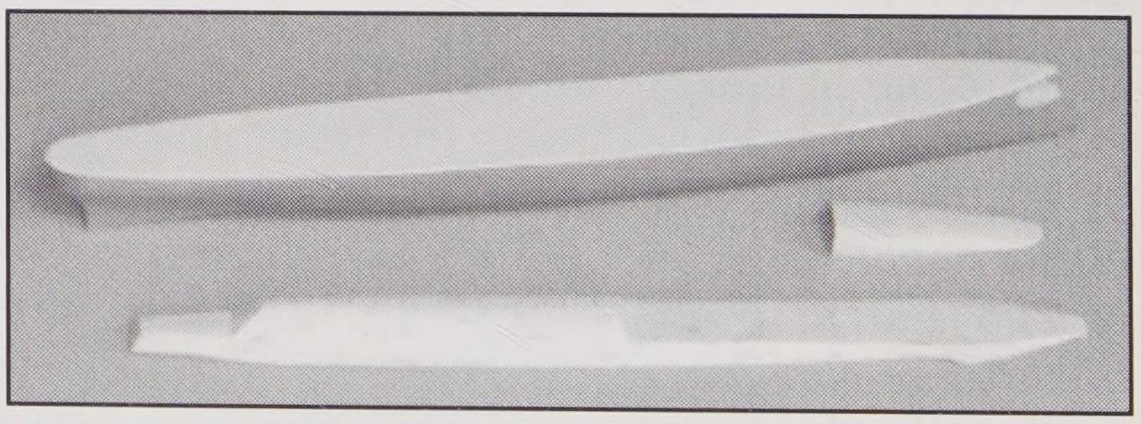


FIG. 9-33: *Vespa's* carved hull with ABS deck and two pieces of the superstructure.

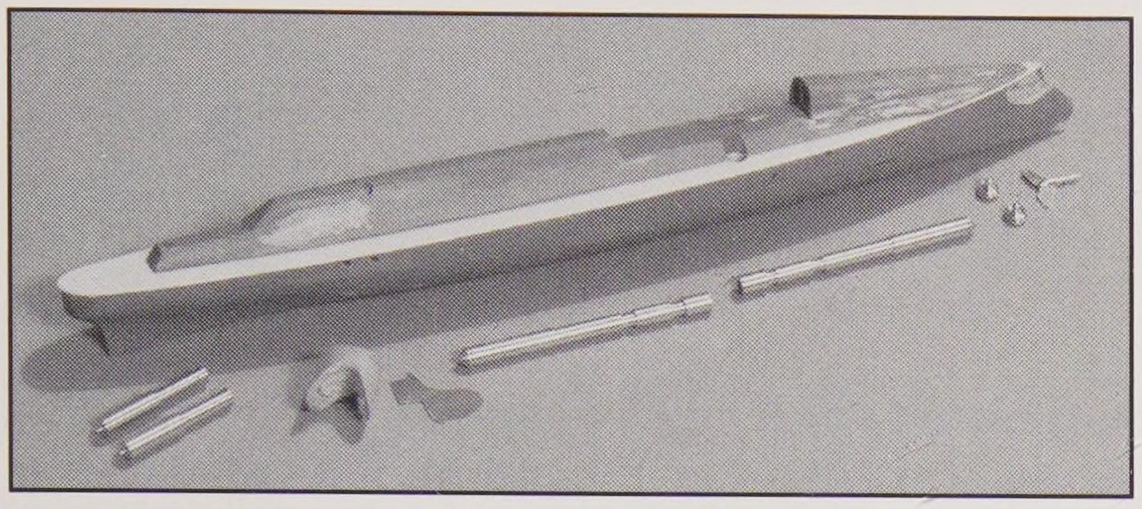


FIG. 9-34: *Vespa* parts before assembly.

the tubes) on the deck to facilitate loading the 14-inch torpedoes. These were laid in the troughs, then slid down the tubes. The stands were removed before sailing. Victorian torpedoes were sharply pointed in the mistaken belief that this was the best shape. It was found later that the modern rounded shape was more efficient.

The oval (in plan) conning tower was made from Perspex. Most small details such as hatch covers were made from brass shim. The grid at the stern was made from a brass grid etching found in my scrap box. (Constantly using the etching process produces ample spare parts which occasionally come in handy.)

Guardrails and handrails were 0.035" tinned copper wire with each joint soft soldered together. The problem here was getting the minimum amount of solder on the joint. Excess solder is very difficult to remove on such delicate work. The secret is to use Baker's fluid, which enables the solder to run easily. A hot iron can then "drain" off any excess solder.

The two cowl ventilators were made from ABS tubing smoothed in with Isopon. Funnels and torpedo tubes were brass turnings. **Fig. 9-34** shows all the parts of the boat before assembly, and **Fig. 9-35** shows the main parts assembled with the

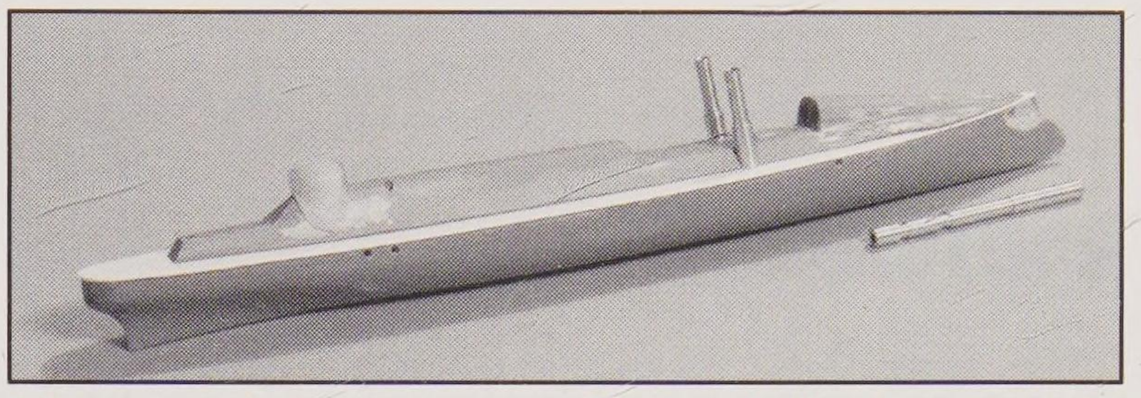


FIG. 9-35: Main parts assembled with the torpedo tube beside the bow.

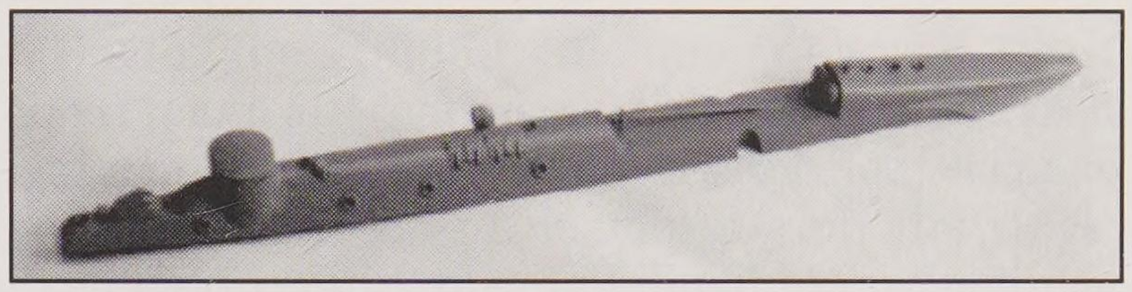


FIG. 9-36: *Vespa's* unfinished, painted superstructure.

torpedo tube beside the bow. (I resisted etching all the details as I normally do, because the amount required was too small to make the initial £70 tooling cost viable.) **Fig. 9-36** shows the unfinished superstructure.

Finishing off the model left me facing a dilemma, as *Vespa's* paint scheme was unknown, but probably all black. Matt black, however, completely hides all detail, which is what it is meant to do. I, therefore, chose dark red antifouling, black hull and deck, and dark grey for the superstructure. A bit of poetic license, I agree, but it makes a more attractive looking model. Incidentally, I used Tamiya's Nato black XF69, which is not dead black but very, very dark grey. Black can be a bit overwhelming on a model, especially a wee one 7.5" long! **Fig. 9-37** (c/s) shows the finished model on its stand. It was mounted on two stainless steel rods screwed into nuts built into the hull.

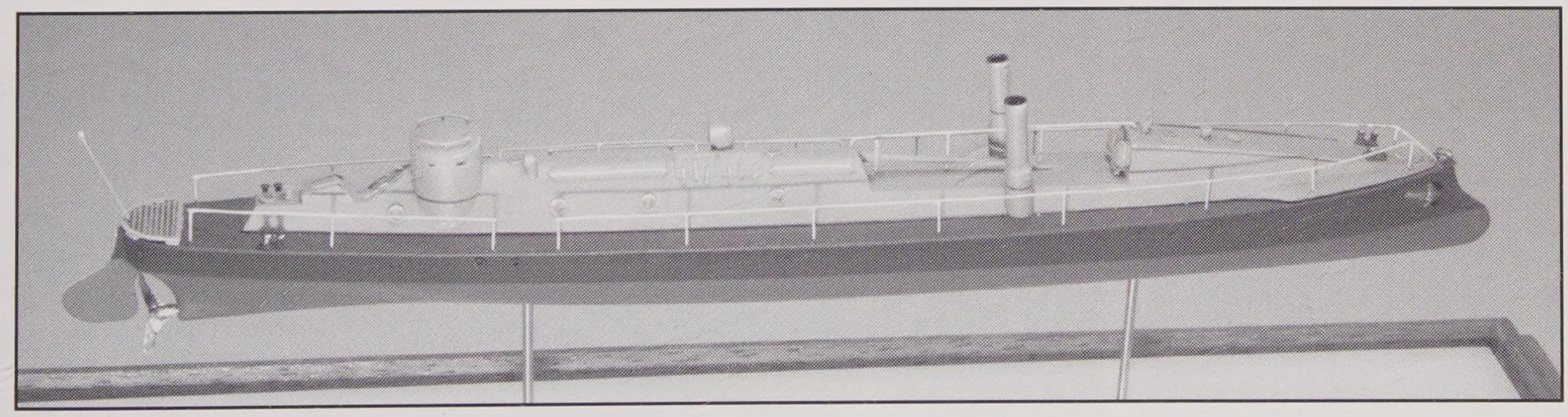
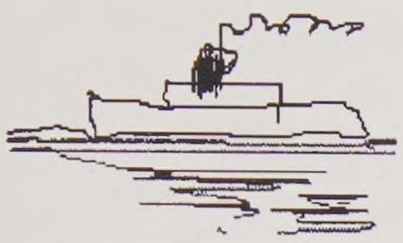


FIG. 9-37: Finished model of *Vespa* at 1:100 scale.

Chapter Ten



Ventilators

Cowl ventilators provide one of the headaches associated with building Victorian battleships, as some literally sprout forests of the things! My method in the past was to "tin bash" the cowl part from copper sheet and solder these to a copper tube. However, this is not an easy method. It requires skill, patience, and most of all, access to a large heating torch to anneal the sheet about 12 times whilst forming the cowl. *Magnificent's* cowl ventilators were made this way (**Figs. 10-1** (c/s) and **10-2**), as were the six on *Empress of India* (**Fig. 10-3**).

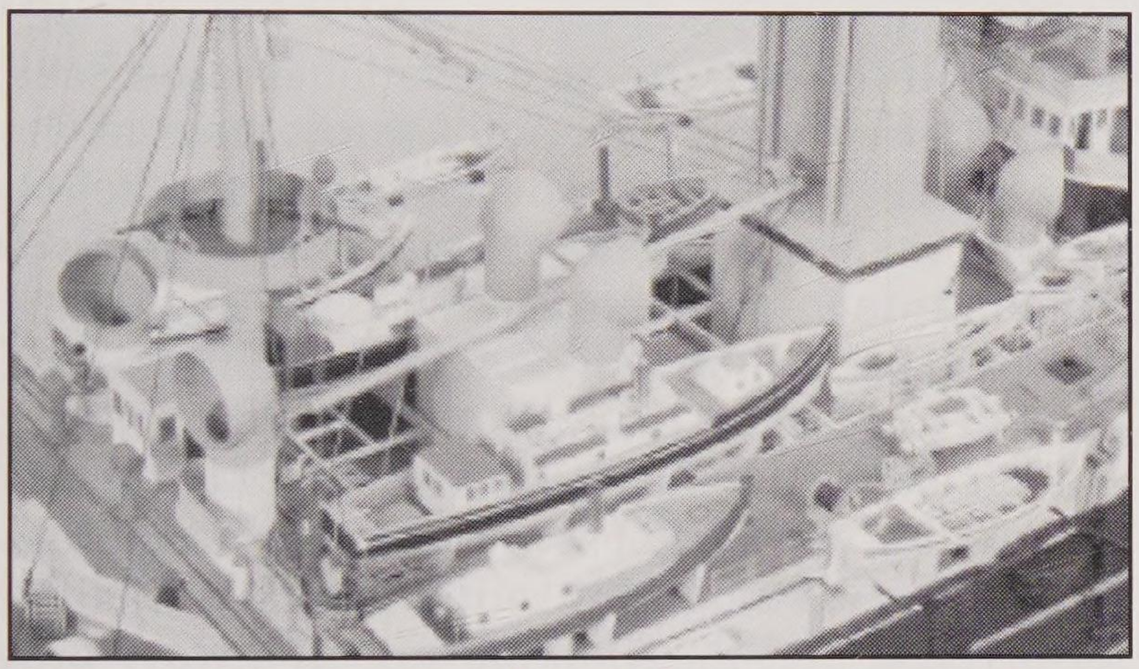


FIG. 10-2: Some of *Magnificent's* large cowl ventilators.

Having the skill but, this time, no torch, I cast about for an alternative method. Using purchased white metal or plastic items was rejected, because you would not find a match to your drawings. Even if you could, they fall down in not having a hollow column. I thought of making them in two halves split vertically, using either vacuum forming or hot water moulding like I did for the ship's boats. The effort involved in making the tools put me off that idea which, given good tool making, would probably work well. Then it occurred to me to substitute ABS sheet for the copper, but otherwise follow my original method.

When fabricating cowl ventilators, the first step is to list their sizes and see if some rationalisation can be achieved. Victorians loved to make each vent a different size for no good reason that I can see. Nearly all *Duilio's* cowl vents could be made using two sizes of cowl, although two were oval and the rest circular. I decided that the oval ones would be circular (and damn the torpedoes!) and thereby accommodate the two-size classification. This meant two punches and two dies. **Fig.**

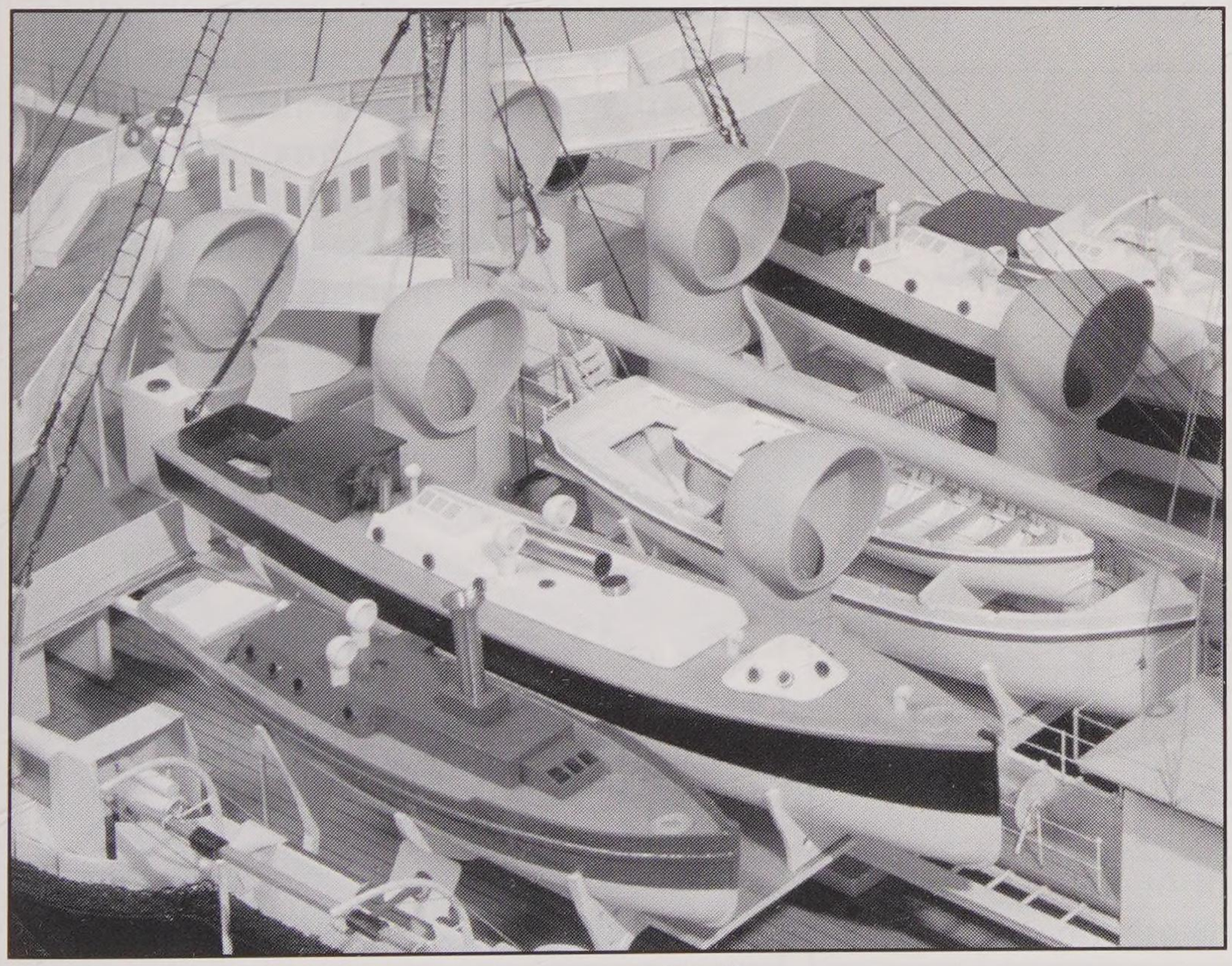


FIG. 10-3: Cowl ventilators on *Empress of India*.

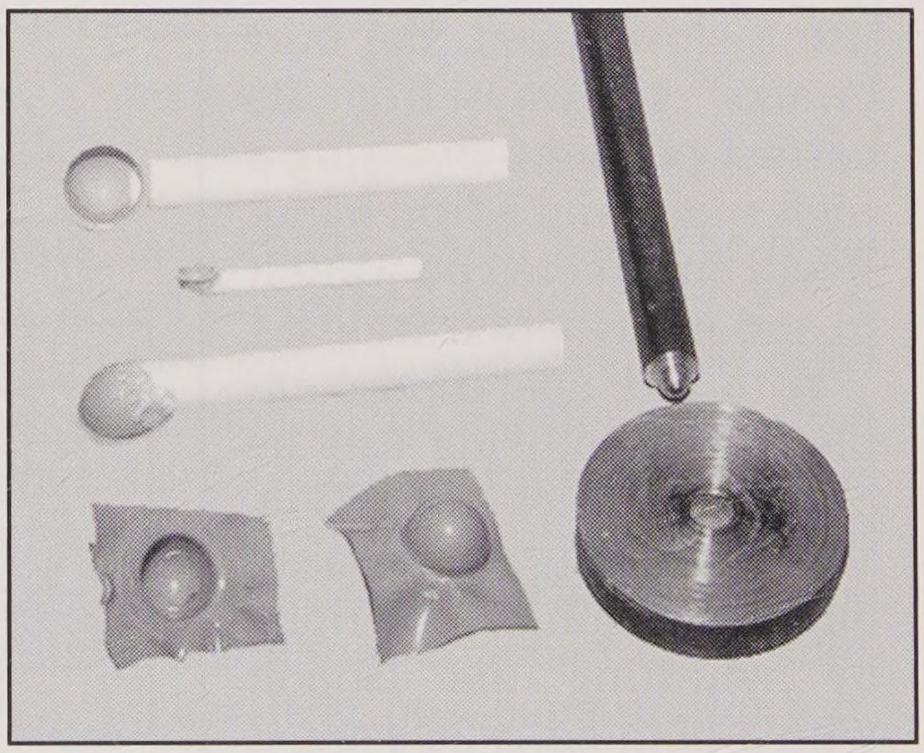
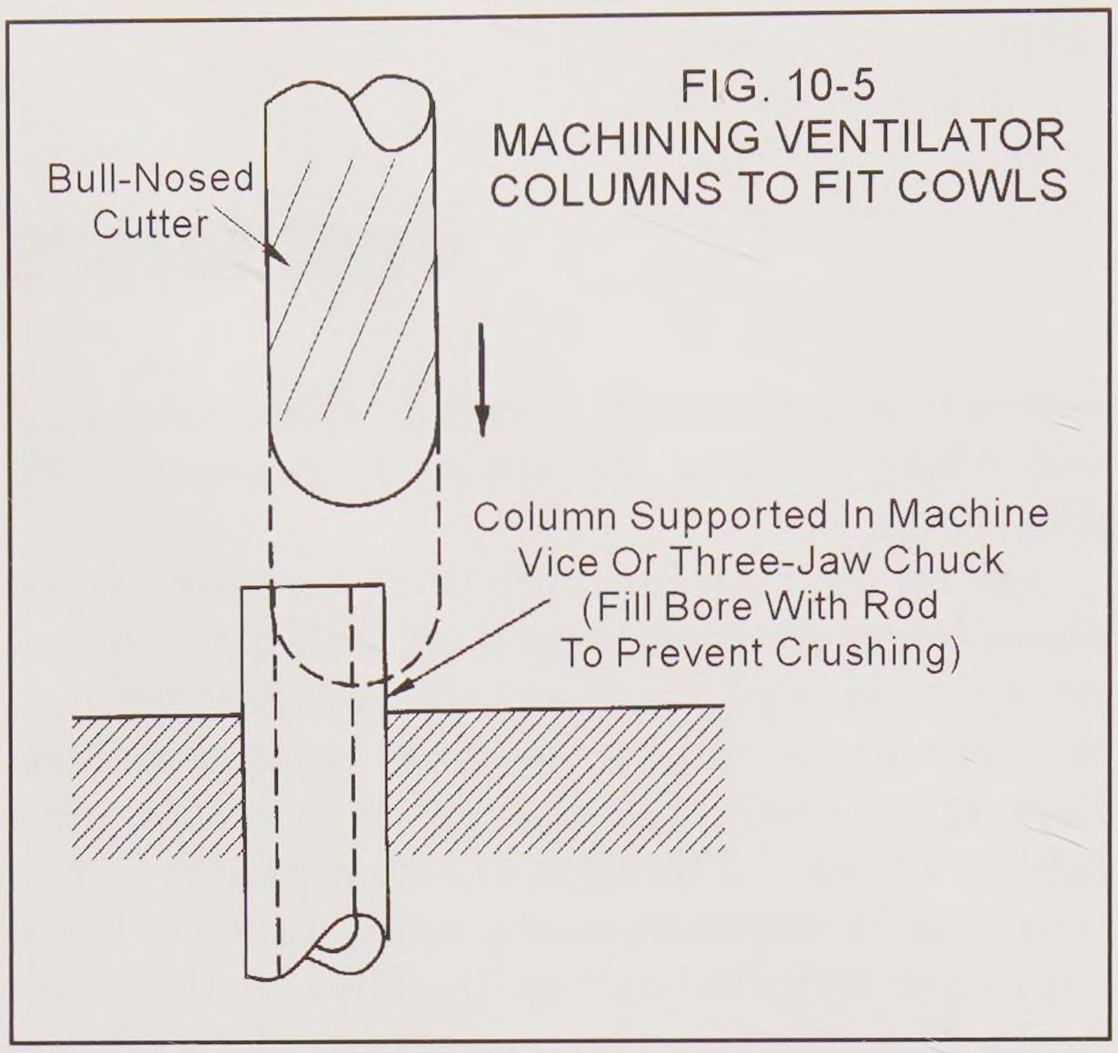


FIG. 10-4: Brass punch and die are to the right. Untrimmed ABS cowl to the left with finished vents above.



10-4 shows one set of tools and the moulded cowls from them.

I bought some ABS tubing for the columns. For the larger size, I found a bull-nosed milling cutter that fit the cowl's outside curvature. Using the vertical milling machine, the top of the column was machined to fit the cowl (**Fig. 10-5**). The bore was filled with a rod to prevent crushing.

The two were cyanoed together, then the gap filled and smoothed with Isopon (David's P38). Before cleaning the outside (to maintain maximum strength in the joint), the column's interior hole was cut with a spherical dental burr. Run the burr very fast to do this. If you use a slow speed, the burr "walks" sideways from its correct position. By using a high speed and a firm hand, it will cut where you want it to and not where it wants!

With this operation completed, the outside can be cleaned. Riffler files (**Fig. 10-6**) probably work best, but a good job can be done by whittling the Isopon with a pointed, #26 scalpel blade whilst still in its "green" state.

FIG. 10-6: Riffler files.

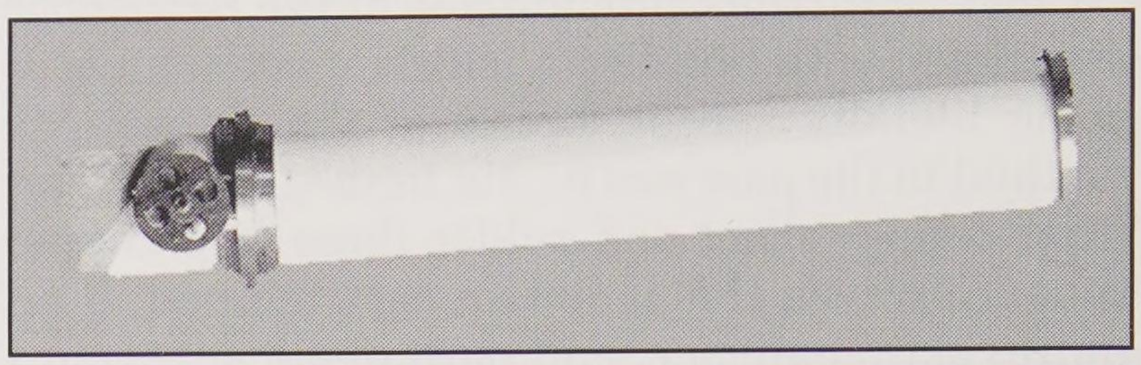
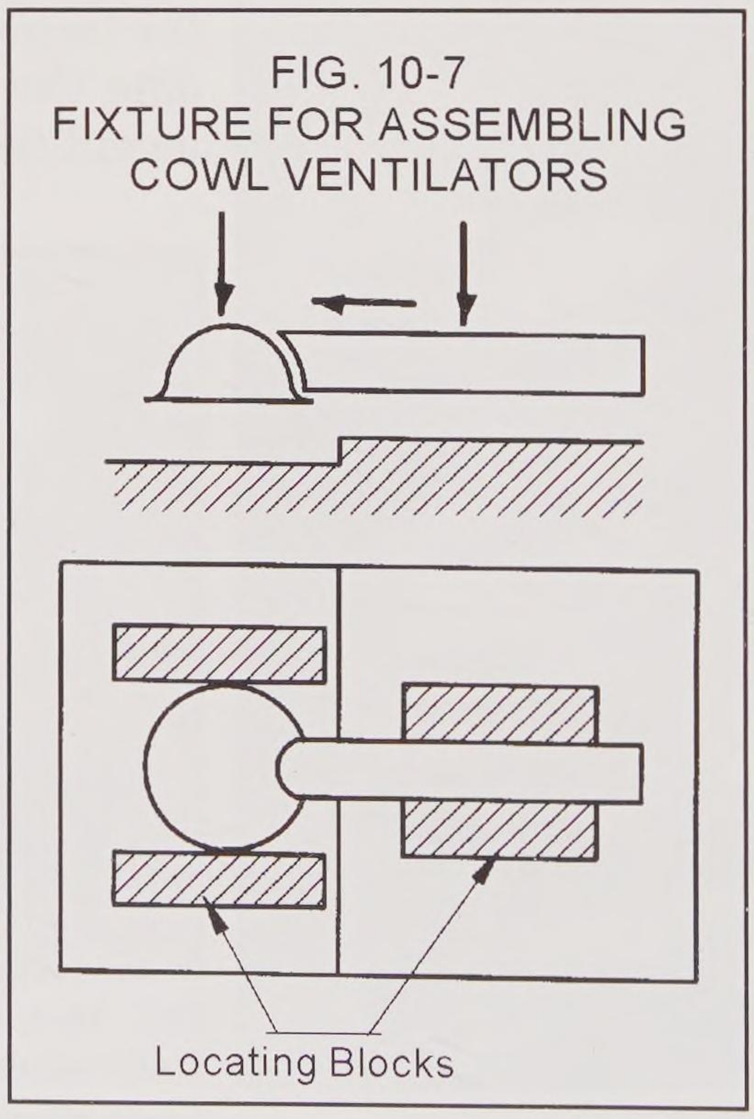
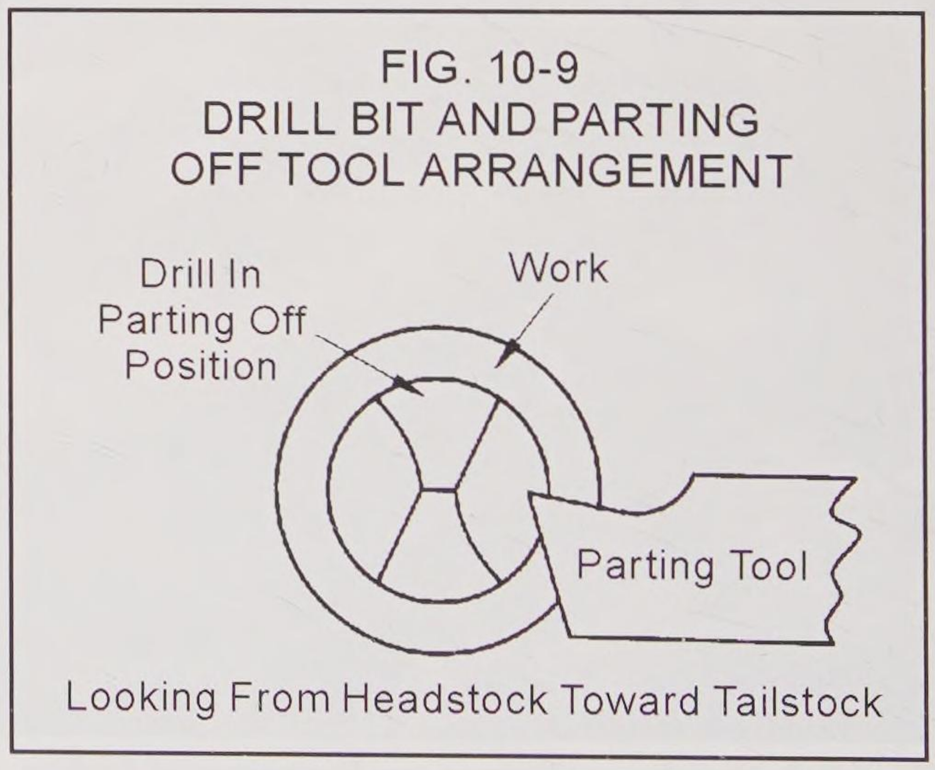


FIG. 10-8: Cowl vent equipped with a rope/chain-operated mechanism to turn the head. The two brass bands are turnings.

If a bull-nosed cutter is unavailable, use a scalpel or chisel to cut the end of the column at the appropriate angle (found by trial and error) before carving in the mating curve. Make a simple, two-level fixture to assemble the two parts (**Fig. 10-7**). This can be elaborated to hold the column and cowl in the correct plan position.

Each column had either one or two joining sleeves (**Fig. 10-8**). These were turned from brass rod and are a straightforward job. One difficulty, however, is that the final parting off always produces a burr inside the bore at the parting off point. This can be difficult and time-consuming to remove, especially if the part is tiny, as it always ends up on the floor! It is best not to form the burr in the first place – prevention is better and all that jazz! So, if the drill bit is left in place whilst parting off, its flute edges will re-





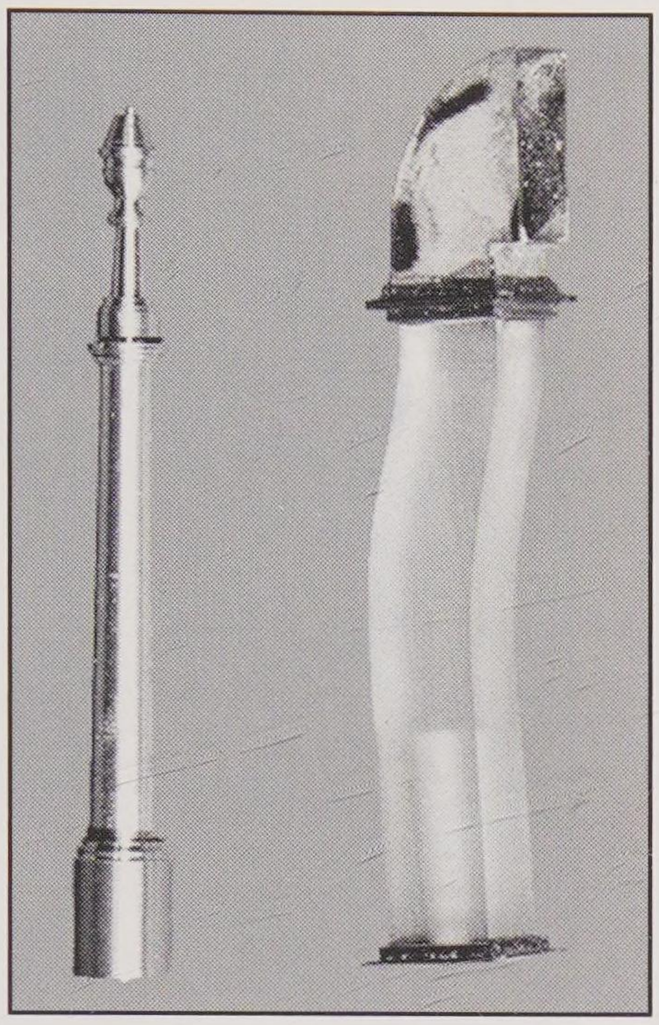


FIG. 10-10: Rectangular ventilator for *Duilio* with master binnacle to the left.

move the burr. Just be sure a flute space is opposite the parting tool; otherwise, the tool will hit the drill, which is not a good idea for either one. **Fig. 10-9** shows the arrangement of a drill bit and parting-off tool to prevent a normal parting-off burr.

Square section ventilators

Victorian ships also had square sectioned ventilators (**Fig. 10-10**). (The master binnacle in the photo was made from two telescoping parts. They provided height adjustment, as the height of the flying deck was unknown at the time.) These brackets divorce the binnacle from the vent. The Perspex body was a solid with the cowl created from two etchings soldered together (**Fig. 10- 8**). In cases like this, make the back (curved piece) longer than calculated and trim after assembly.

Angle iron joined the original's various sheet metal sections. **Fig. 10-11** shows how these joints were simulated using plastic angle (Plastruct or similar). **Fig. 10-12** shows an attempt to etch *Duilio's* "pram hood" ventilators. The sections were going to be brass etchings with the dark areas indicating half thickness. However, this method proved messy and very difficult. Instead, a one-piece hood was made with half-etched division lines (**Fig. 10-13**).

Fig. 10-14 shows a group of ventilators grouped around *Duilio's* fore funnel. The lower two rectangular vents have etched grids. Note the bilge pump to the left of the assembly.

Some ventilators have a grid over the cowl opening and, occasionally, the interior of the cowl is painted red. Large cowl ventilators have two straight members shaped like a plus sign across the cowl to stabilize the opening (**Fig. 10-15**). The lower vent has a handhold attached to its side. Note the flag locker (egg box construction) attached to the conning tower, and the extensions on the bridge for holding the lower ends of the shrouds.

FIG. 10-13
FINAL ETCHING DRAWINGS
FOR "PRAM HOOD" VENTILATORS

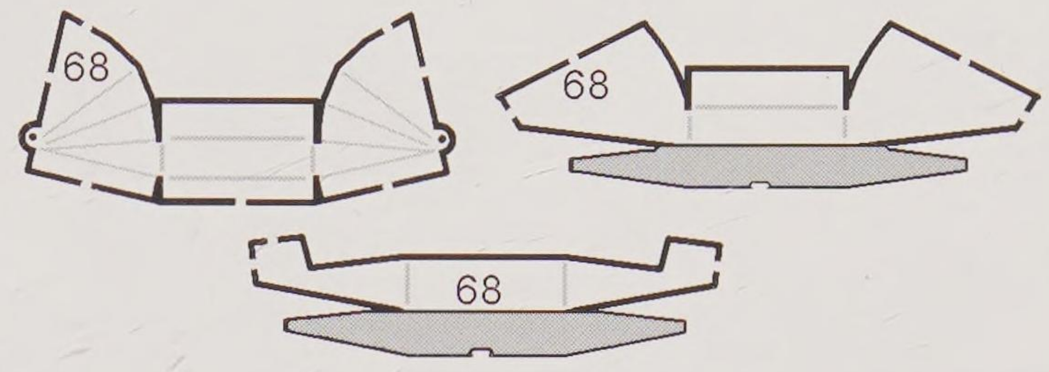
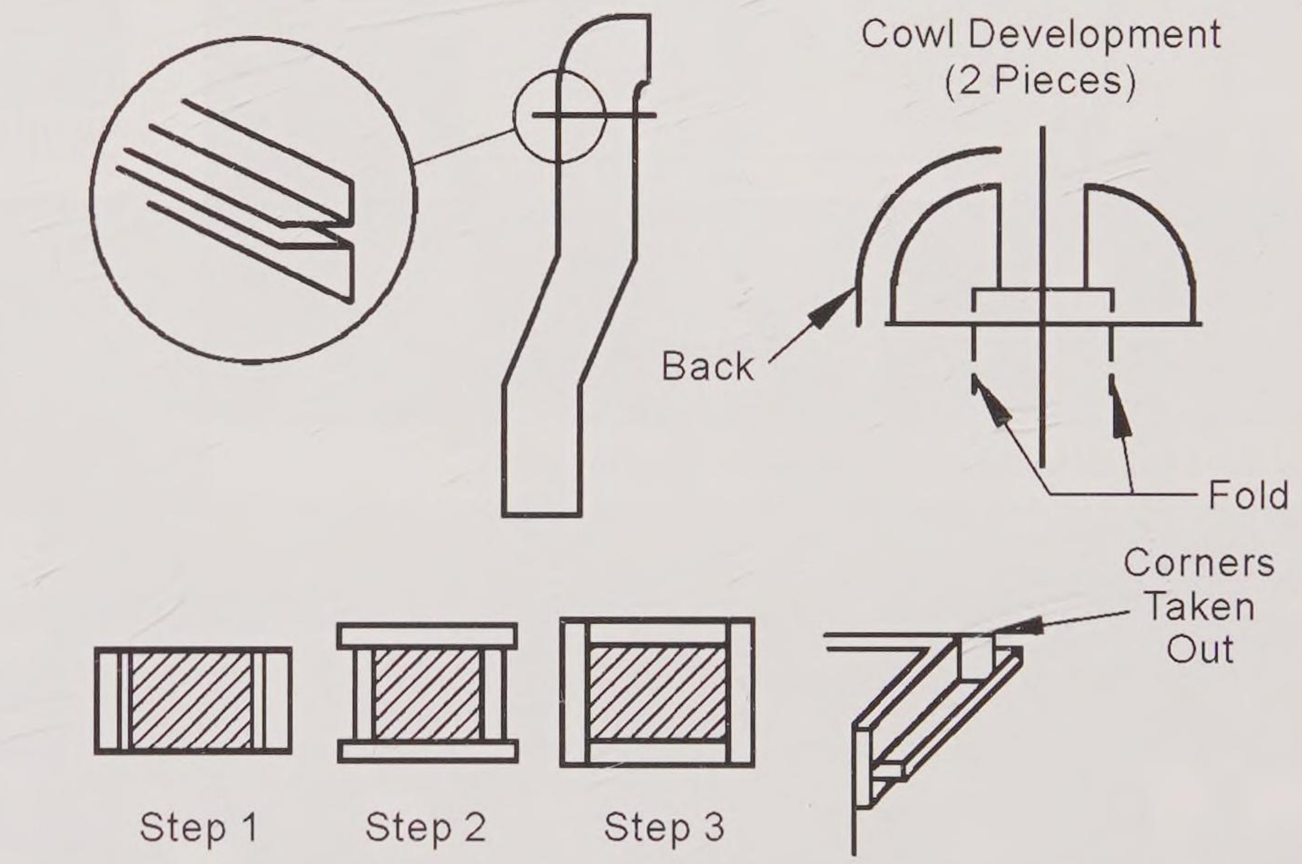


FIG. 10-11
MANUFACTURING DRAWINGS FOR RECTANGULAR VENT



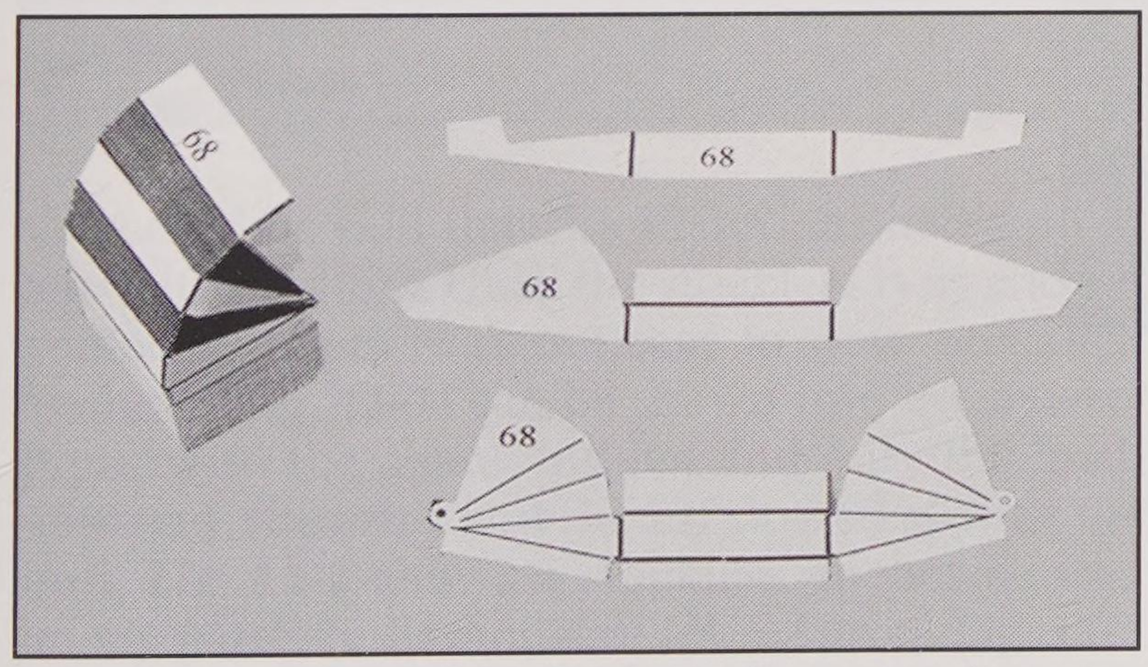
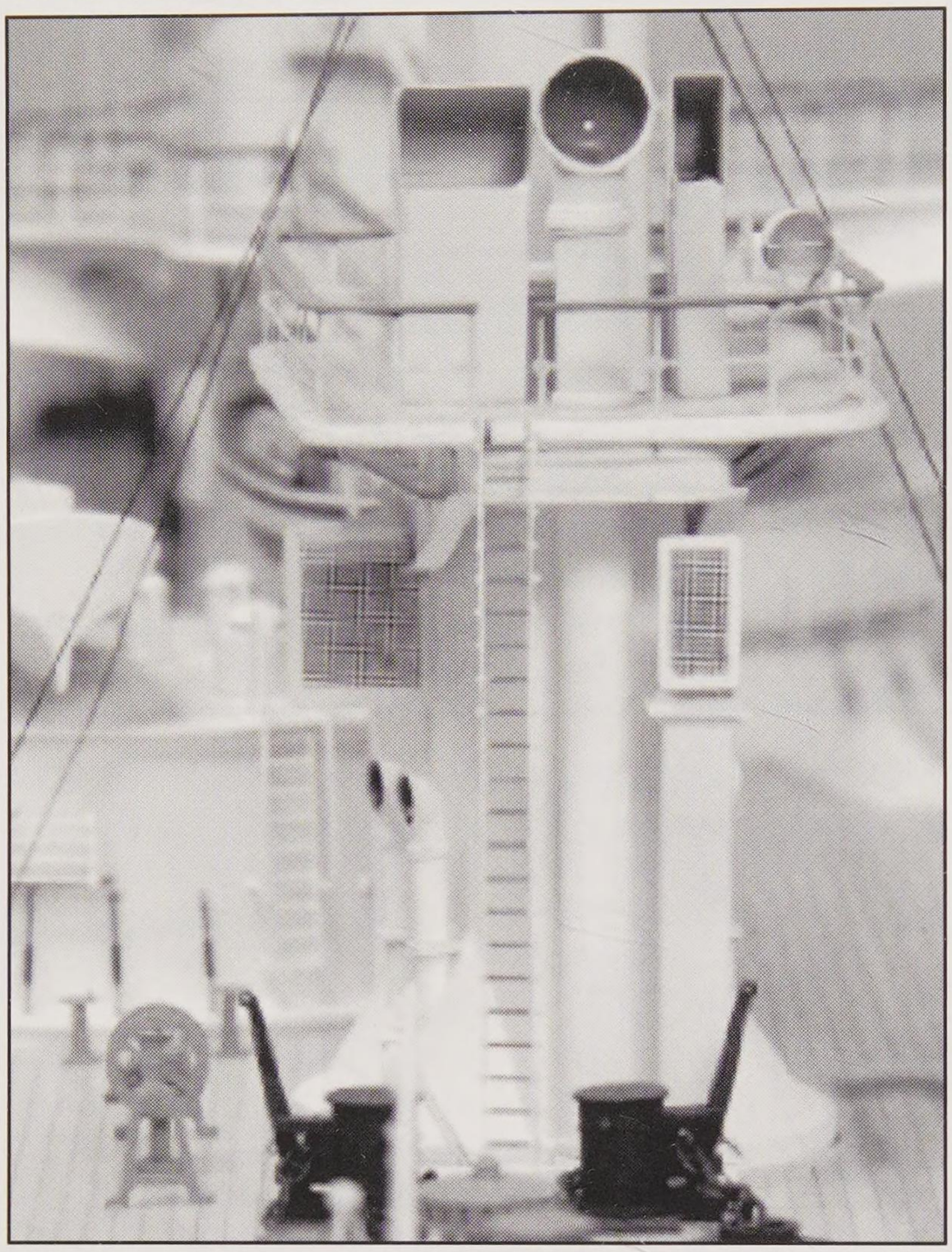


FIG. 10-12: An attempt to etch *Duilio's* "pram hood" vents.

Fig. 10-16 (c/s) shows the forest of ventilators on *Empress of India* and **Fig. 10-17** shows a few on *Victoria's* fore deck.



FIG; 10-14: Collection of vents on *Duilio*.

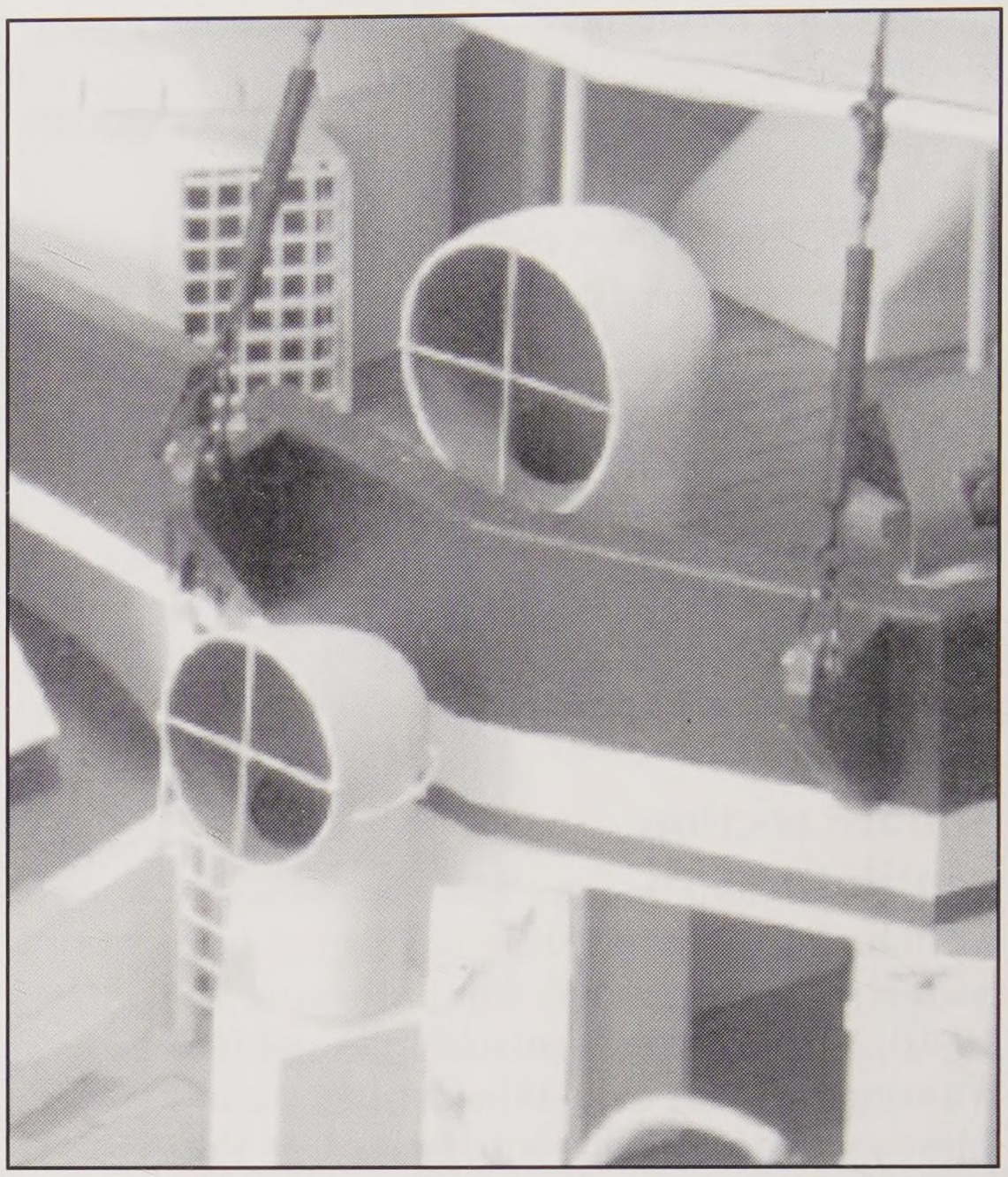


FIG. 10-15: Cowl vents with cross bracing to strengthen the opening.

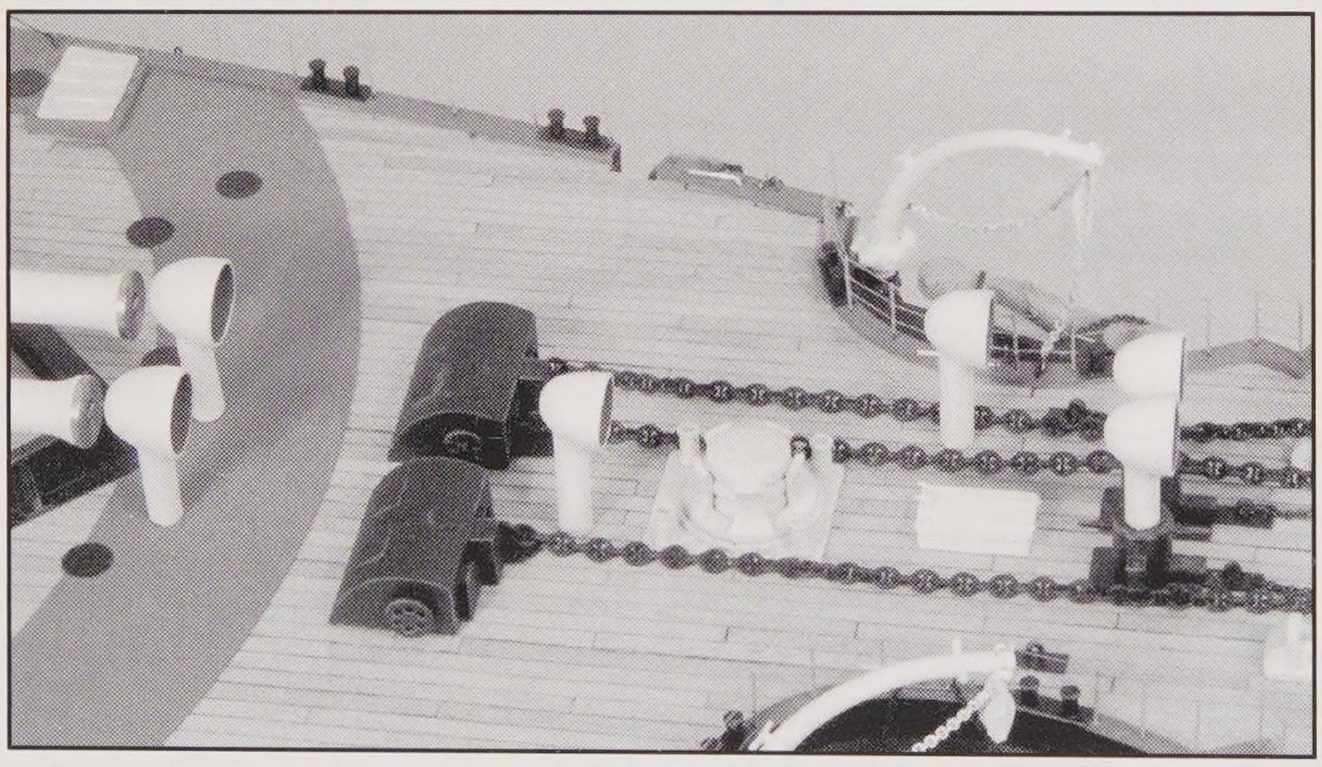
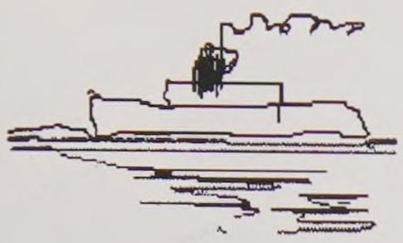


FIG. 10-17: Small vents on *Victoria's* fore deck.



Chapter Eleven

Anchors and Stowage

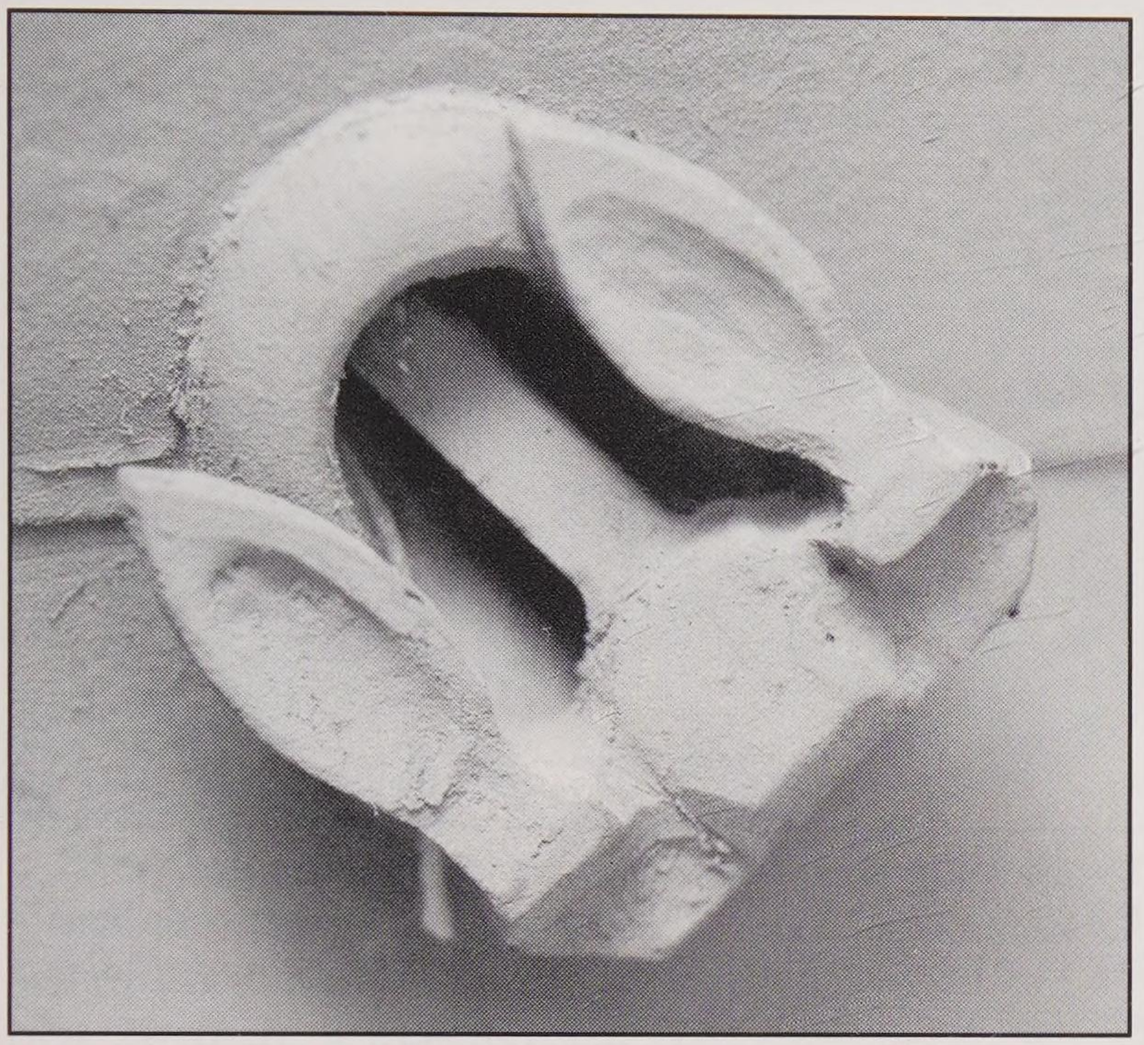
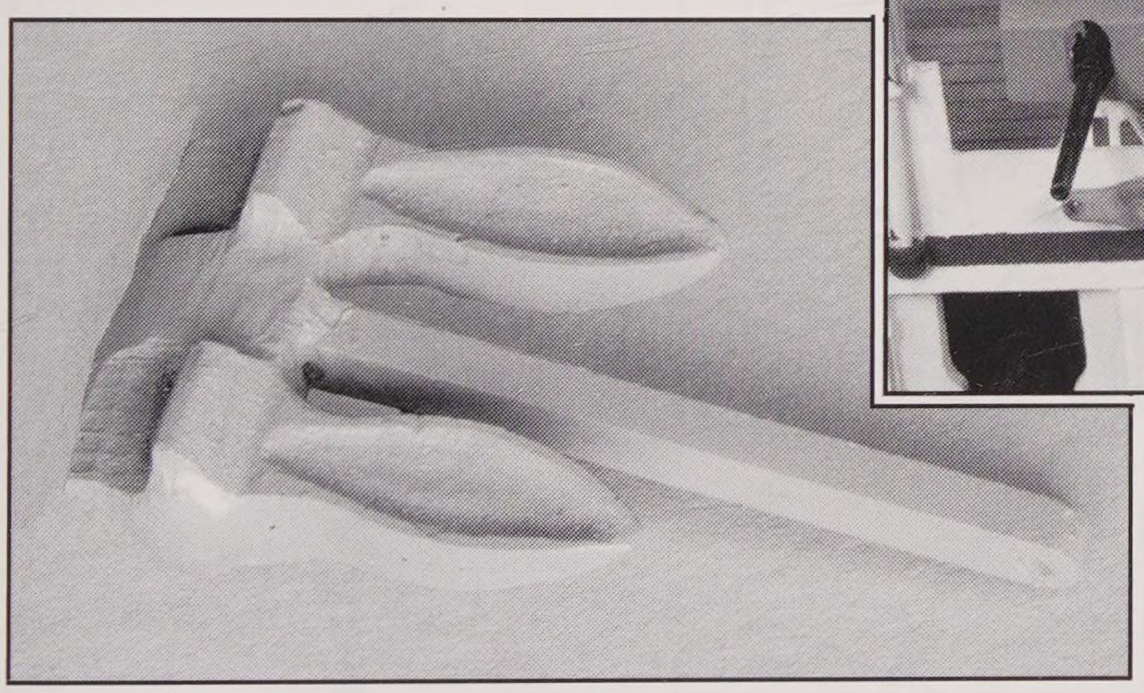


FIG. 11-2 (above): Stockless anchor stowed on *HMS Anson*.

FIG. 11-1 (below): Stockless anchor.

FIG. 11-4 (right): Unfinished anchor beds on *Duilio*.



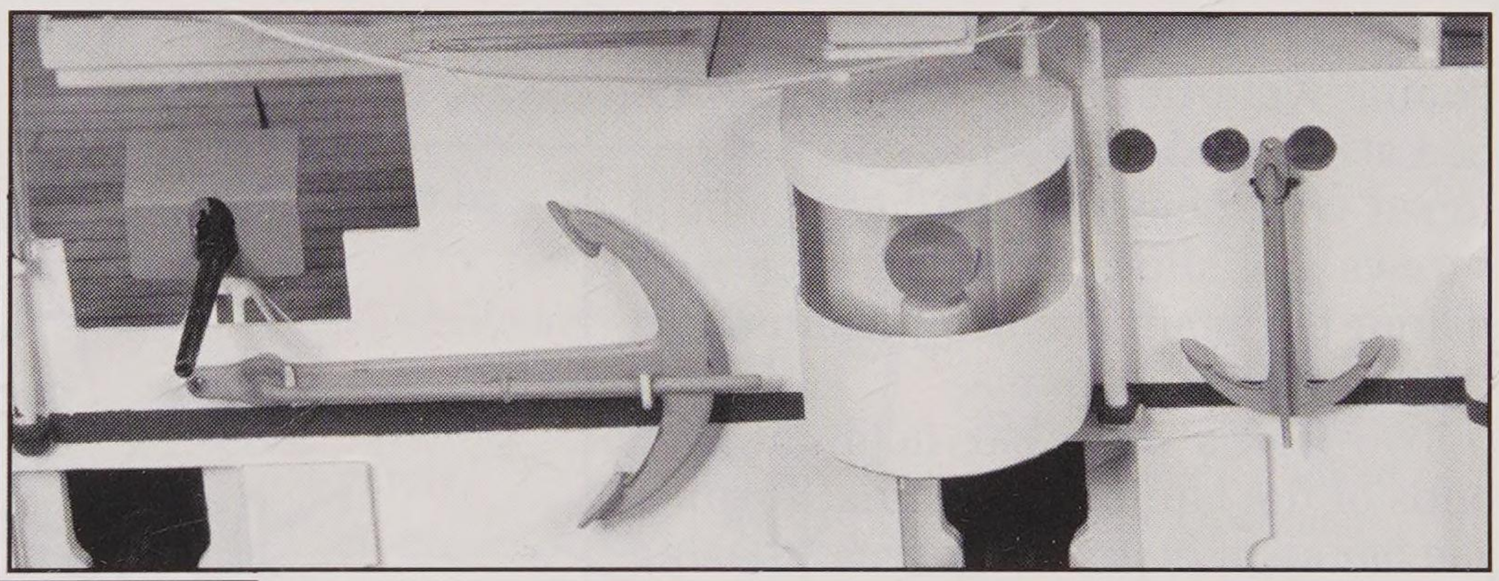
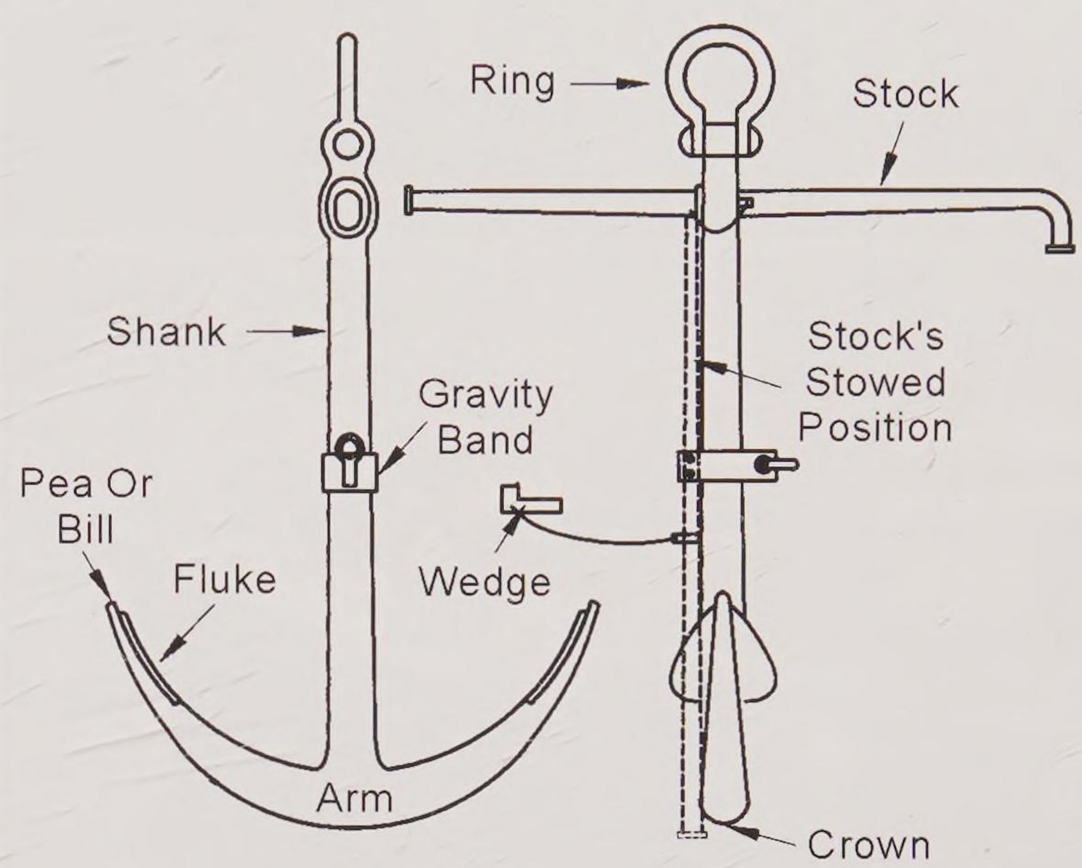
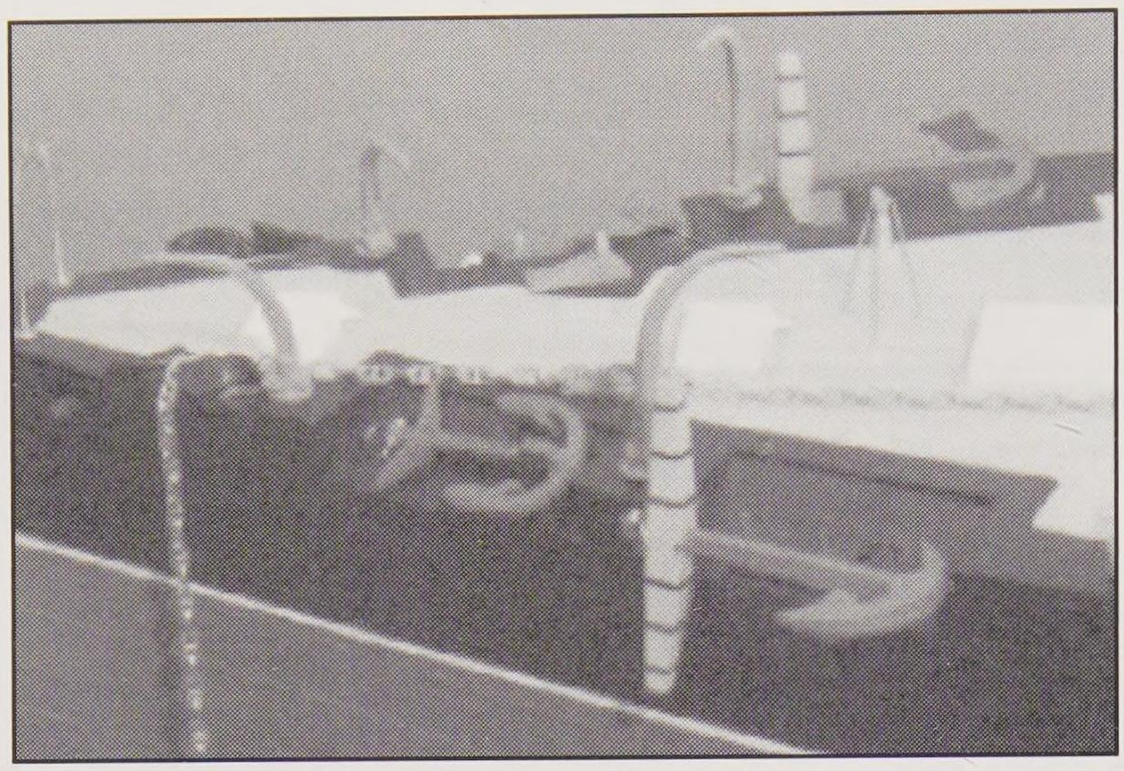


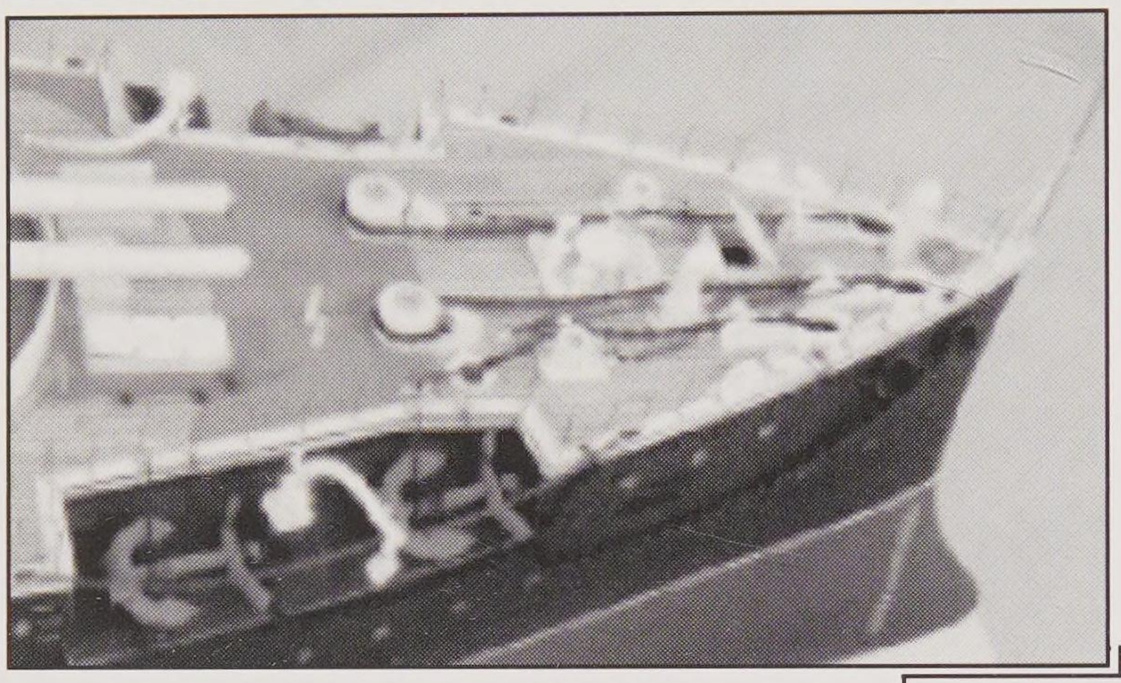
FIG. 11-3
ADMIRALTY PATTERN ANCHOR



It could be said that the Victorians had a problem with anchors. Until the stockless type was invented, anchors were not easy to stow. Stockless anchors (**Fig. 11-1**) can be drawn into the hawsepipes with the shank hidden and only the business end, the arms and flukes, stowed against the hull. **Fig. 11-2** shows a stockless anchor stowed on my partly built model of *HMS Anson*. **Fig. 11-3** shows an Admiralty pattern anchor with its parts named, and **Fig. 11-4** shows two of these anchors stowed on *Victoria*.

The Victorian anchor had a stock that precluded this stowage method, so two different arrangements were devised. The main one was the use of anchor beds. **Fig. 11-5** shows *Duilio's* unfinished anchor beds, and **Fig. 11-6** shows *Magnificent's* completed anchor beds. These flat areas on the bows of the ship were inclined to 20° and equipped with two slides on which the anchor was positioned. Two launching chains, one at each end of the shank, effectively held the anchor in place until one or both chains were released, allowing the anchor to slide off the bed and into





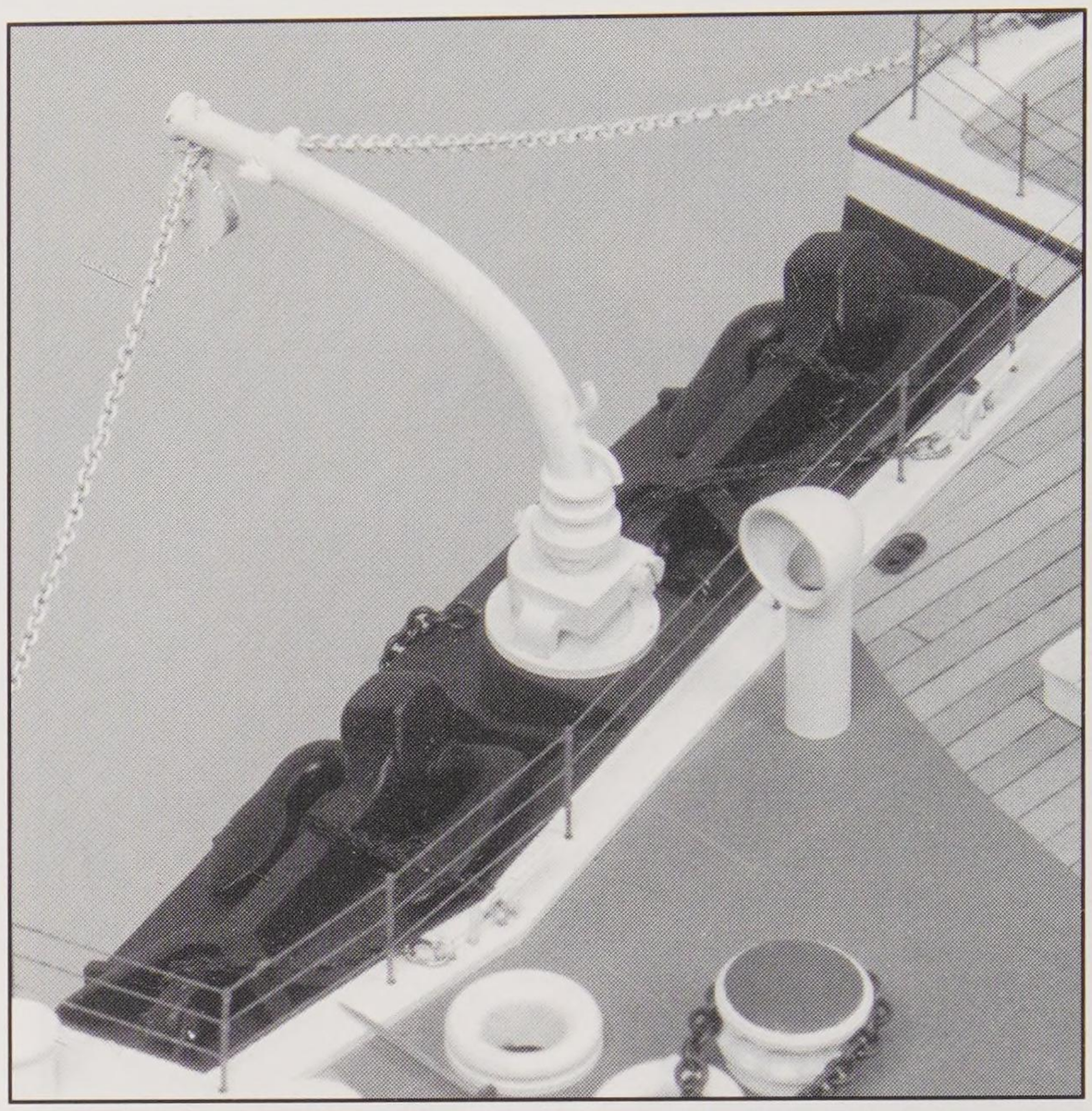


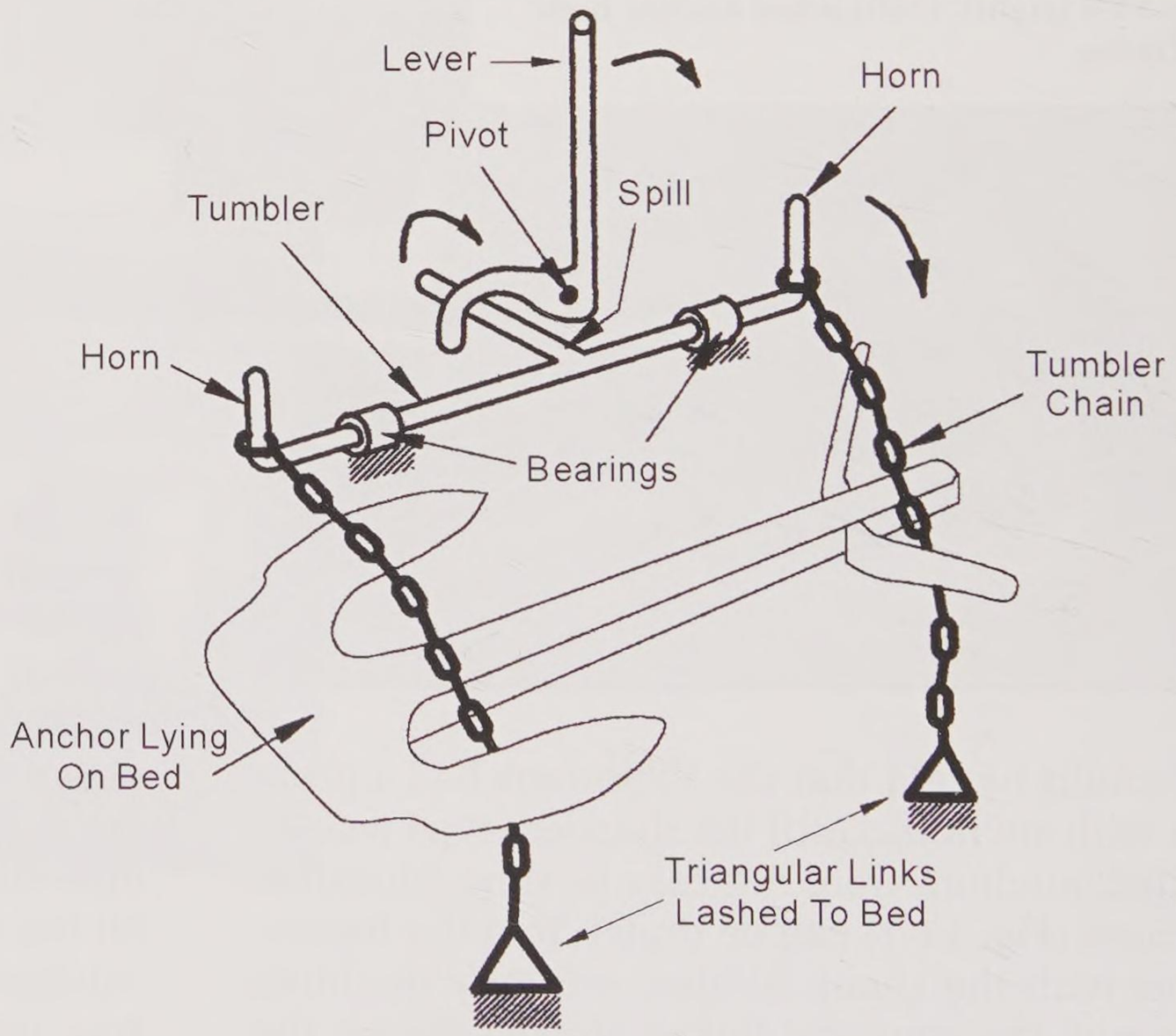
FIG. 11-5 (top left): Unfinished anchor beds on *Duilio*.
FIG. 11-6 (center left): *Magnificent's* finished anchor beds.
FIG, 11-9 (above): Black anchors on *Empress of India* "disappearing" into their black anchor bed.

the sea. Other permanent security chains were normally secured to the bed at one end. The other end was fastened with hempen lashings or bottle screws and slips. These were cast off before the main securing chains during launching.

Two horns on a bar held the free ends of the launching chains. Turning the bar also rotated the horns, causing the chains to fall off and the anchor to splash into the sea (**Fig. 11-7**).

Fig. 11-8 (c/s) shows one of *Victoria's* anchors lying on its bed. In all probability, this anchor was painted black, making it almost invisible in its black bed. Although not correct, the writer thinks painting the anchor slate grey is allowable on the grounds that, first and foremost, the model is a work of art. Keep it black if you must, but give me a bit of artist's licence. **Fig. 11-9** shows the black anchors on *Empress of India* blending into their anchor beds.

FIG. 11-7 – TUMBLER RELEASE MECHANISM



Pulling Lever Clockwise Rotates Tumbler, Releasing Tumbler Chains From Horns. Anchor Then Slides Off Bed Into Sea.

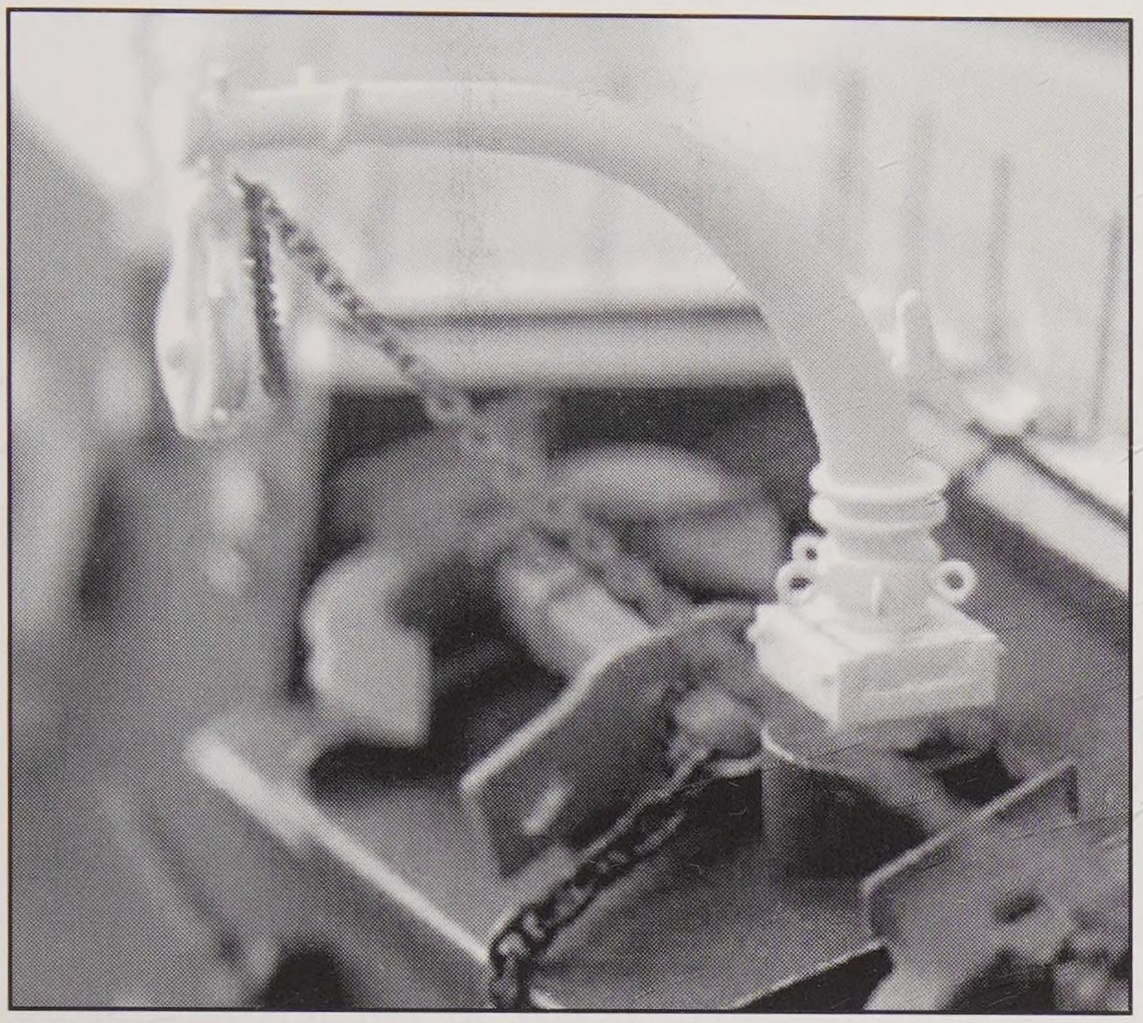


FIG. 11-10: Cat davit on *Magnificent*.

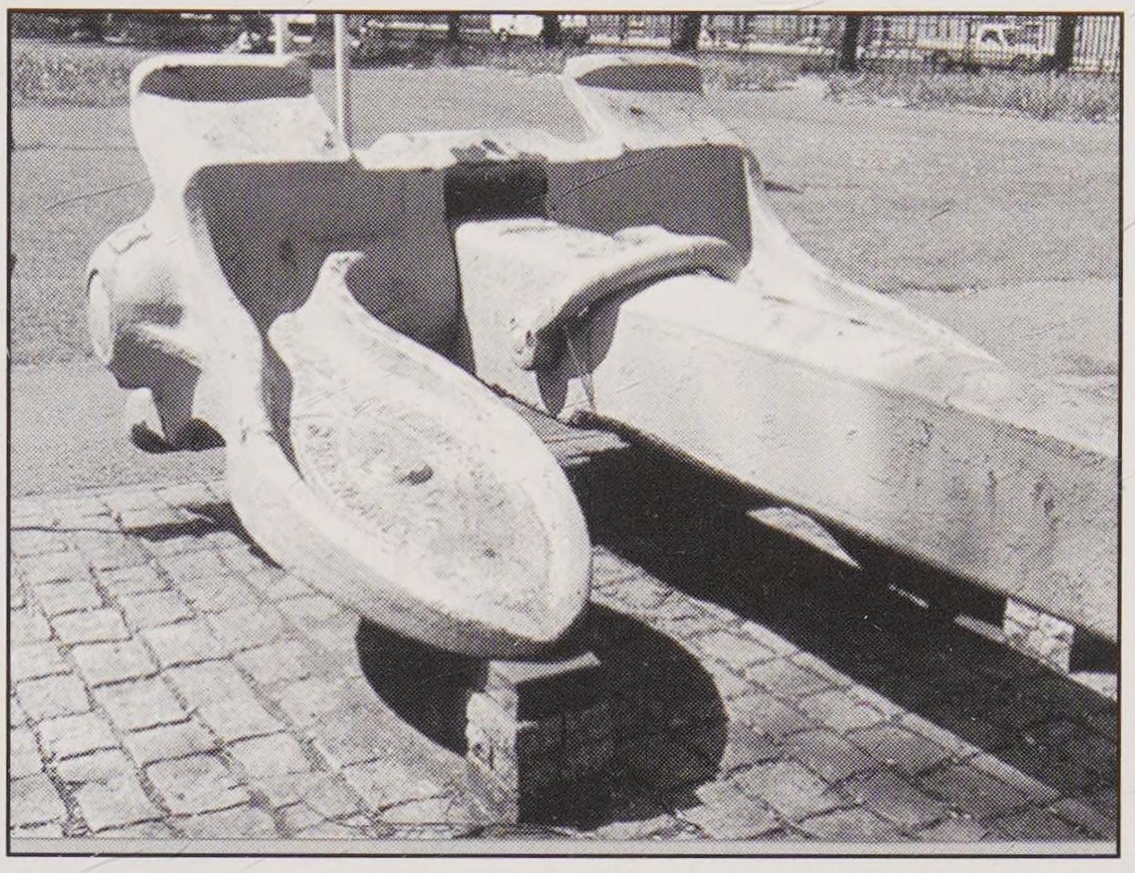


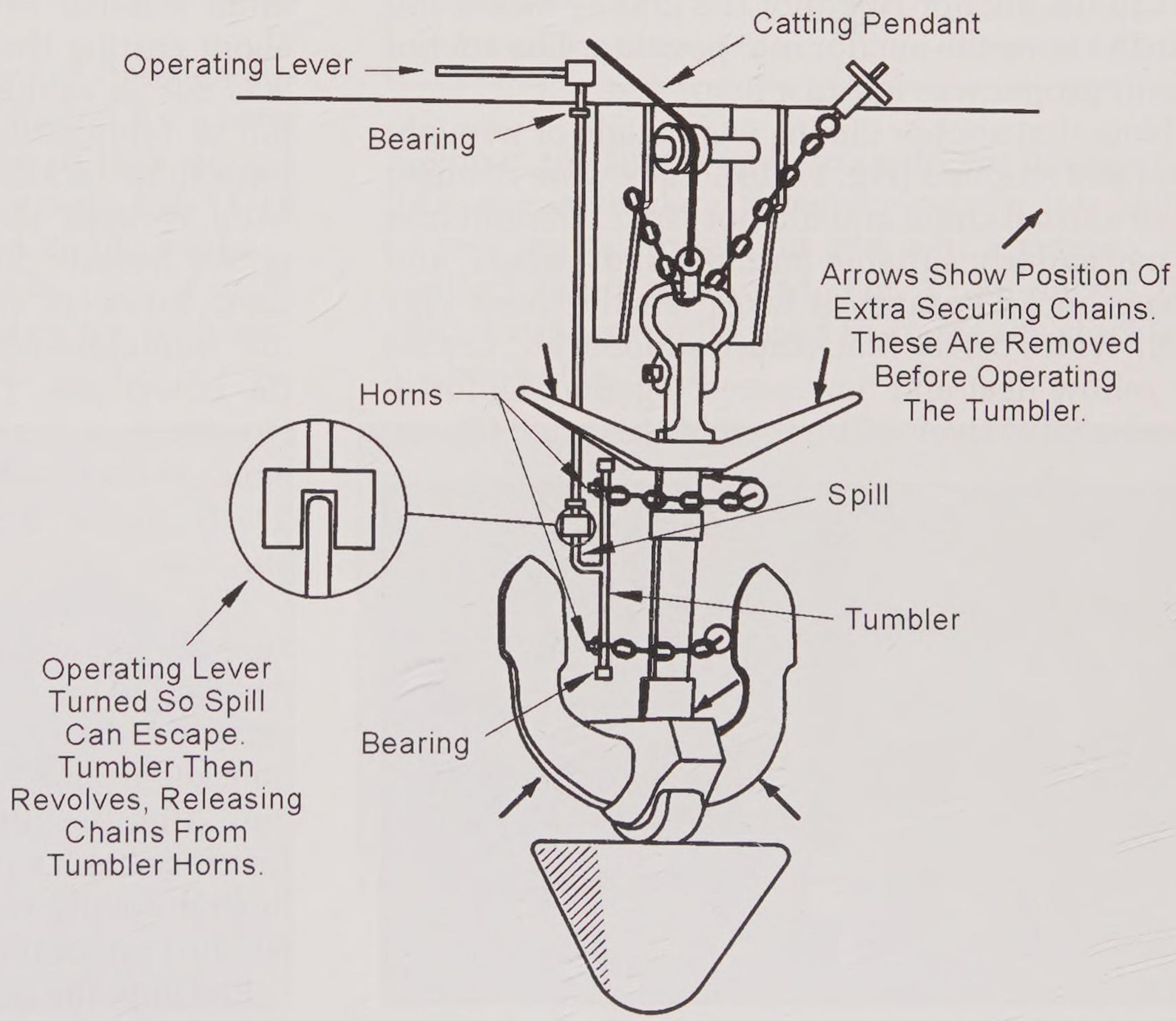
FIG. 11-12: Large anchor on display at the National Maritime Museum.

Cat davits

After use, the anchor could not be stowed by simply hauling in the cable (chain) as in modern practice. Instead, a massive cat davit was sited near the beds. A hinged base enabled it to be folded flat against the deck when the ship went into action. Cat davits are shown in **Figs. 11-9, 11-10**, and **11-11** (c/s). Davits were secured to gravity bands on the shanks of the anchors. As the name vaguely suggests, gravity bands were at the point of balance, which resulted in the anchor taking up a horizontal position so it could be hoisted in, laid on its bed, and secured. **Fig. 11-12** shows the gravity band on an anchor's shank. The head can swivel slightly on the shank, and the head of the pin allowing this movement is on the left-hand end.

Although the system worked well, it took up a great deal of space at the bow, particularly when two bower (the largest) and two sheet anchors were carried. A lesser arrangement was to carry a bower and sheet on the starboard side and one

FIG. 11-13 – VERTICALLY STOWED ANChOR AND TUMBLER RELEASE MECHANISM


Catting Pendant
Operating Lever
Bearing
Arrows Show Position Of Extra Securing Chains. These Are Removed Before Operating The Tumbler.
Horns
Spill
Tumbler
Operating Lever Turned So Spill Can Escape. Tumbler Then Revolves, Releasing Chains From Tumbler Horns.
Bearing

bower on the port side. Stowage must have required immense manpower, as anchors on a battleship weighed between 6.25 tons and 7.5 tons (6,350kg and 7,620kg).

An alternative way was to mount them vertically (**Fig. 11-13**). This method was adopted for anchors at the stern, possibly where no flat deck space was available. The same securing and releasing principles applied as with anchors on beds. The main support was a small projection on the hull on which the anchor rested in an upright position. In this case the releasing rod, the tumbler, was vertical, but it still had two horns for releasing the securing chains. A lever at deck level operated the tumbler. Again, additional security chains were released before the main securing chains during launching.

A "clump cathead" instead of a cat davit was used. This vertical structure housed a sheaf over which the catting pendant was rove. It was shackled to the anchor ring (not the gravity band) and used to hoist the anchor into position. The anchor chain proper was left in a loop.

Note that anchor chains were made of wrought iron and studded (**Fig. 11-14**). They were stronger than normal chain and did not kink. Wrought iron is particularly suitable for chains, drawbars, and crane hooks because it takes tensile stress very well. It also can be blacksmith welded; i.e., heated to yellow heat and hammered together. Unfortunately, mild steel will not weld this way. (To see what an artist can do with wrought iron, go to Hampton Court and look at the Jean Tijou screen lying between the palace and Thames River – genius!)

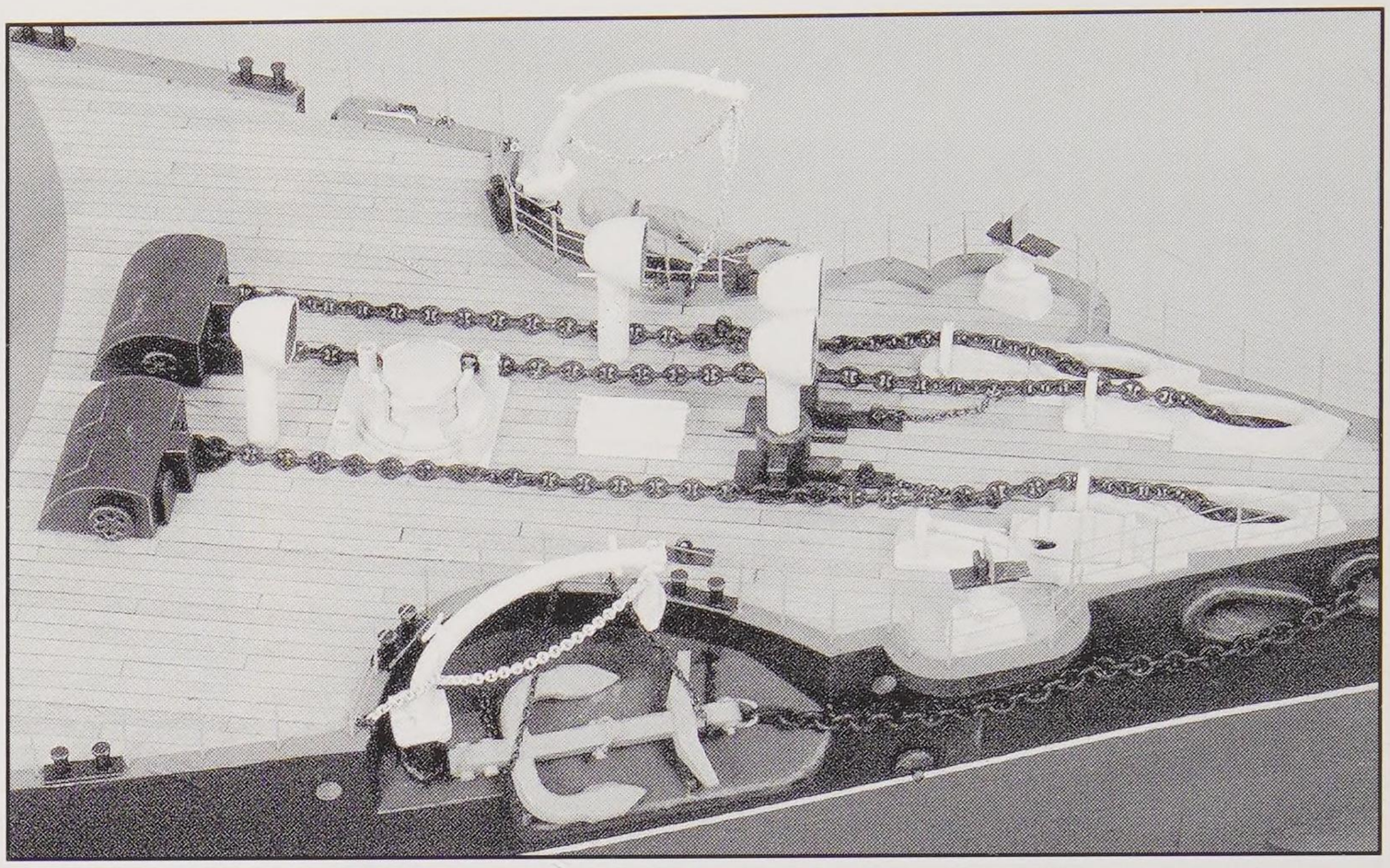


FIG. 11-14: Overhead view of the chain run on *Victoria's* fore deck.

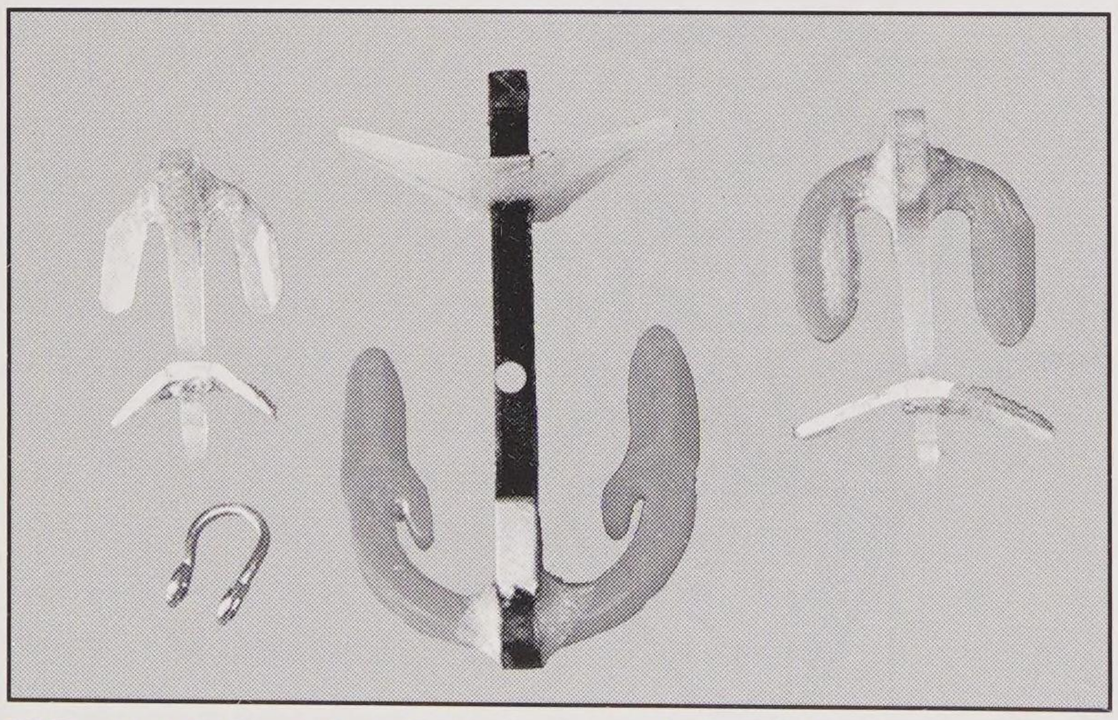


FIG. 11-15: Unpainted anchors and shackles for *Duilio*.

Scale anchors

Duilio required seven anchors with the maximum number of any type being two! Thinking about casting them from a silicon rubber mould was not an option for such a small amount. The job of fabricating each one individually would have to be tackled. In general, the parts were cut from Perspex sheet using a hand fretsaw (my power fretsaw does not cut Perspex well). Some parts, however, were cut from Paxolin sheet (phenol formaldehyde reinforced with paper) using the power saw. Thermosetting materials such as Paxolin do not melt, and this avoids the problems encountered with Perspex, a thermoplastic. **Fig. 11-15** shows *Duilio's* unpainted anchors and shackles.

The parts were cleaned up with a file, making sure the left and right arms matched. These were cyanoed to the shank using the vice jaws as an assembly fixture. They were tacked-glued first and checked from all angles before applying more cyano. After the glue dried, the arms were moulded into the shank with "runny" Isopon. Although the head normally swivels on the shank, it is easier to fix the two sections in their correct relationship.

Profiling the arms and palms was done using a cylindrical dental burr in a miniature drill. Vari-

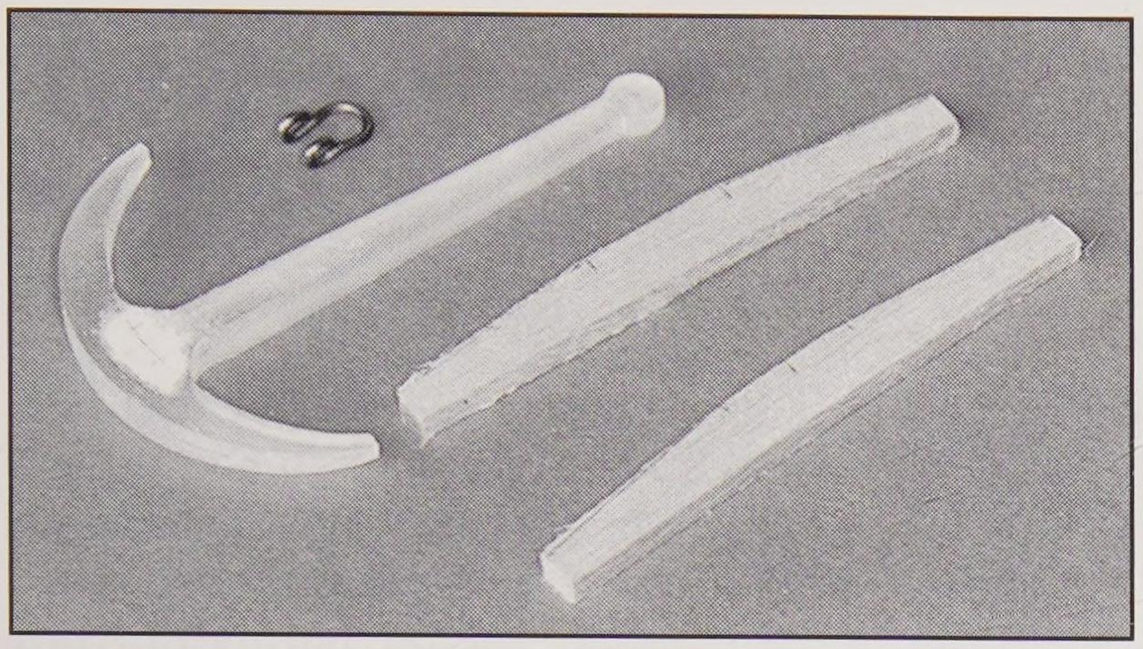


FIG. 11-16: Parts for the main anchor.

ous holes were required for the main shackle and auxiliary shackles. The latter aids "breaking out" the anchor when hauling in.

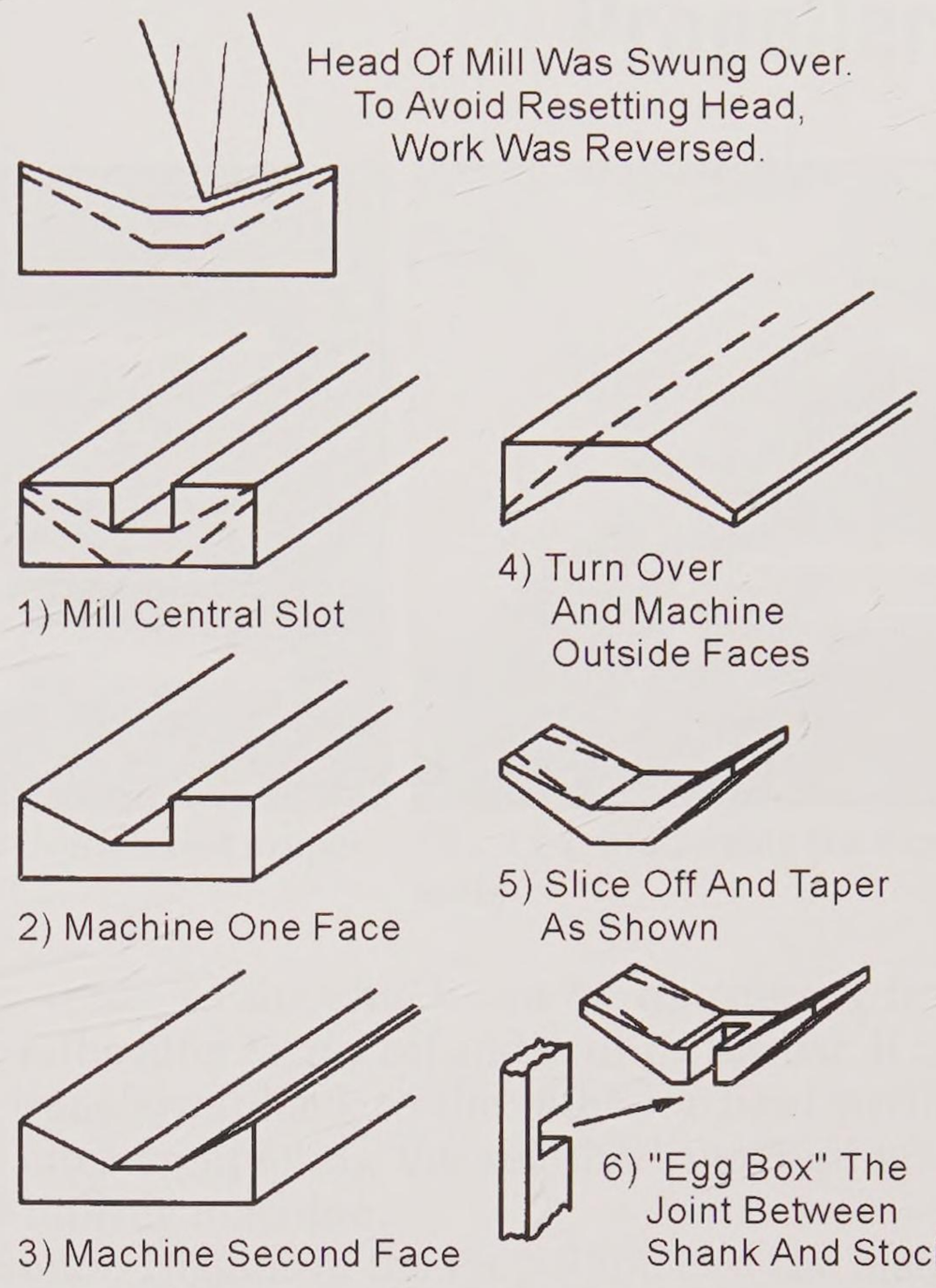
The largest anchor had a wood stock. This required two strips of wood clamped around the shank. I believe daylight should be seen between the strips at the centre to ensure the tightening bands force the wood to grip the shank (**Fig. 11-16**).

The second largest anchor had vee-shaped stocks, which were machined from a strip of Perspex. The head of the mill was swung over (**Fig. 11-17**), then the work reversed to avoid resetting the head.

Fig. 11-18 shows a complete set of finished anchors for *Duilio*. They probably should have been painted black, but are slate grey so they do not "disappear" when placed on their beds. **Fig. 11-19** (c/s) shows some of these stowed on the model.

Silicon rubber moulds should be used if sufficient numbers of one anchor size are required. You can attempt to cast the whole anchor but, remember, the flukes and shank do not necessarily lie in the same plane when stowed. So, it is better to cast the business end and add a Perspex (or similar) shank afterward. **Fig. 11-20** shows the silicon rubber mould used to create the stockless anchor in **Fig. 11-1**.

FIG. 11-17 – MILLING OPERATIONS ON AN ANCHOR STOCK


Head Of Mill Was Swung Over. To Avoid Resetting Head, Work Was Reversed.
1) Mill Central Slot
2) Machine One Face
3) Machine Second Face
4) Turn Over And Machine Outside Faces
5) Slice Off And Taper As Shown
6) "Egg Box" The Joint Between Shank And Stock

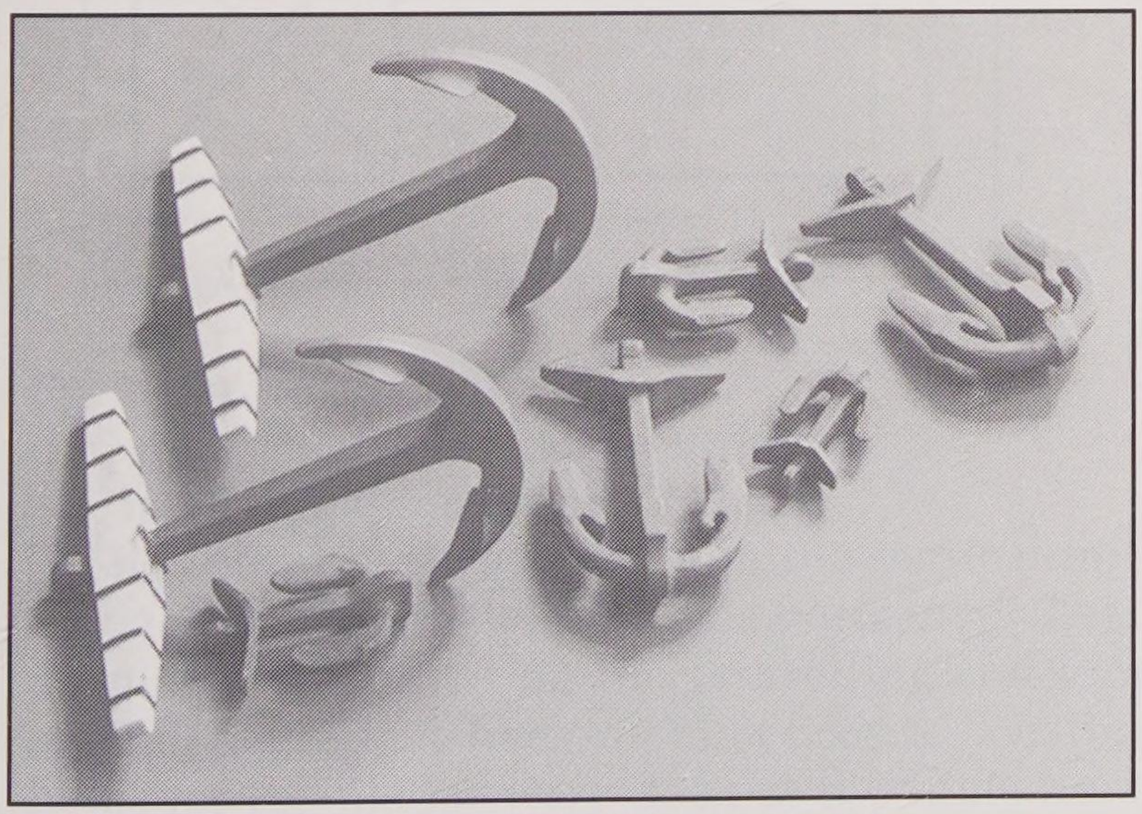


FIG. 11-18: Complete set of anchors for *Duilio*.

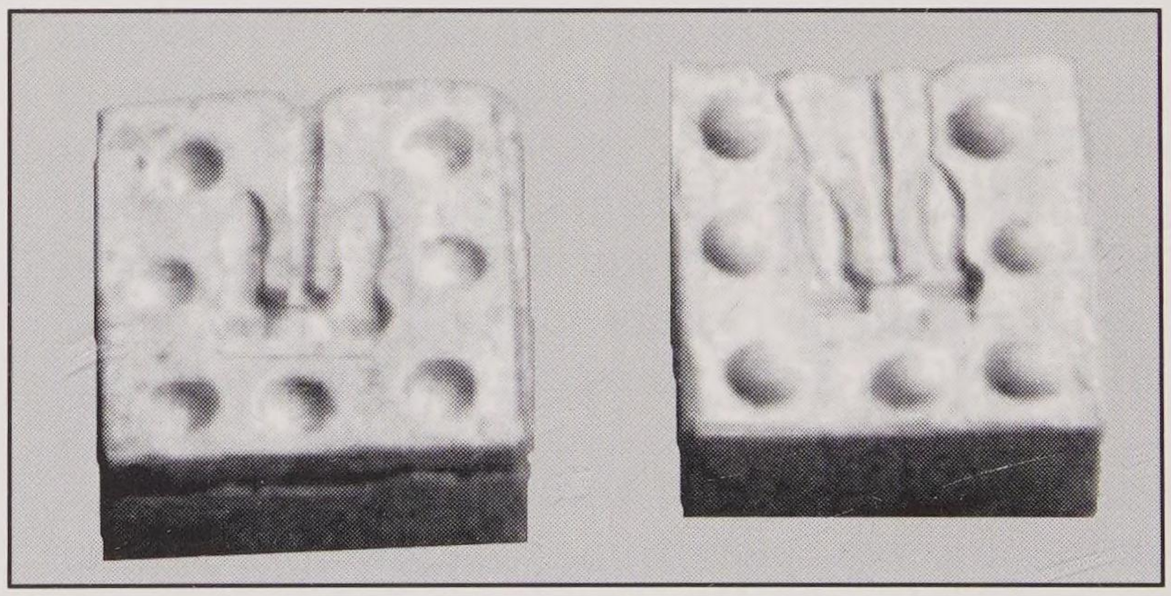


FIG. 11-20: Silicon rubber mould for a stockless anchor.

Chapter Twelve

Propellers

Modern propellers are normally cast in one piece with integral blades and boss. Large Victorian ships, however, had "made up" propellers with the individual blades bolted to the boss. The four blades on *Duilio's* propellers were arranged around a four-sided boss. In 1876, a great deal remained to be learned about propeller design and matching them to the hull's hydrodynamics. To this end, the nominal pitch of the blades could be altered by rotating the blade – to a limited degree and by trial and error – on the boss. This was a dockyard job, of course. Each blade terminated in a flat disc flange that sat on one face of the square boss. Numerous bolts through the flange held the blades and boss together.

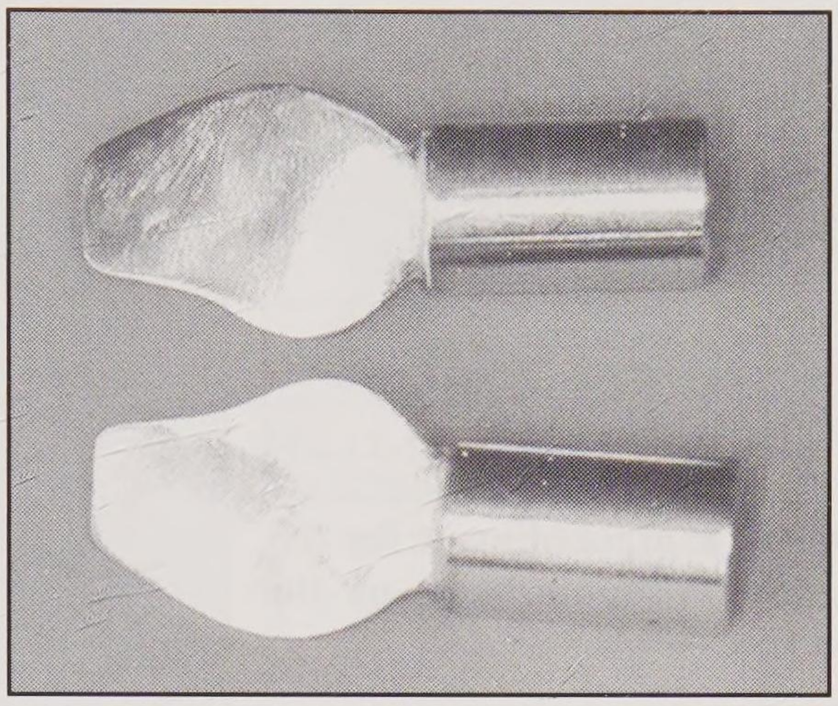


FIG. 12-2: Patterns for *Duilio's* cast propeller blades.

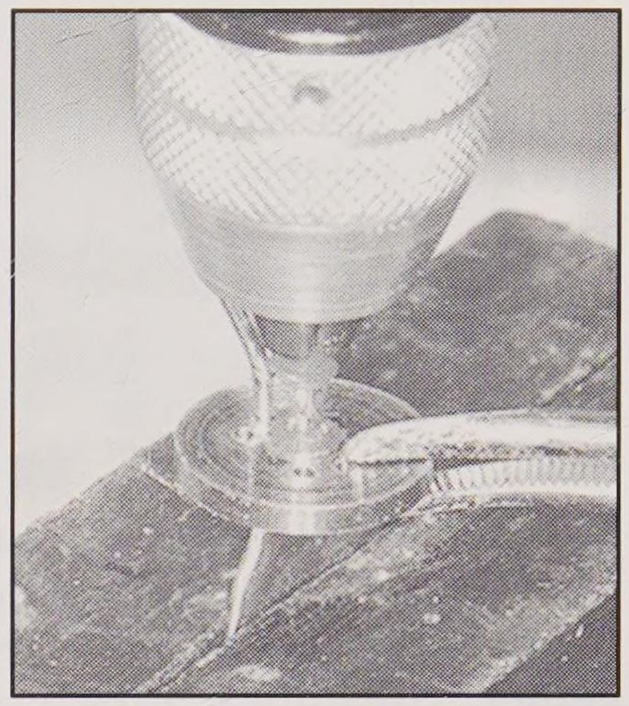


FIG. 12-3: Machining the flange holes.

Making *Duilio's* propellers

The boss was machined from a round bar large enough in diameter to cut the square shape from it. The diameter of the bar can be found by referring to **Fig. 12-1**. The hypotenuse of this triangle is the diameter of the bar.

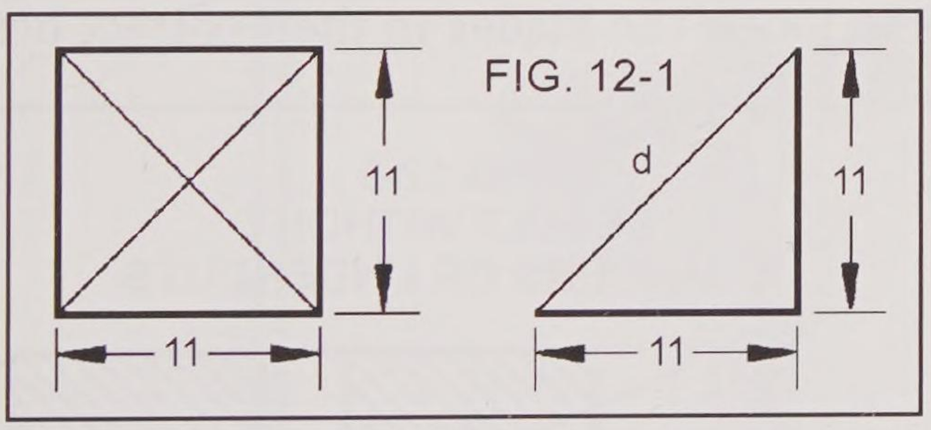


FIG. 12-1

So, according to Pythagoras:

$d = \sqrt{11^2 + 11^2} = \sqrt{242} =$ approx 15.5

Use 16mm diameter or ⅝" stock.

The round bar was set up on the vertical mill using a rotary table with its axis horizontal. Then a square was milled on the protruding end long enough to produce two propeller bosses. Locating holes for the blades were done at the same time. My Myford three-jaw chuck will fit onto my rotary table, so the chuck can be transferred from the lathe after facing off and drilling the bar. It can be transferred back to the lathe for final parting off after completing the required machining on the milling machine.

Simon Higgins of the Prop Shop cast the blades via the lost wax process from two (right- and left-hand) patterns I supplied. **Fig. 12-2** shows the pattern blades soft soldered into a 15mm long by 10 diam cylinder large enough to hold in the lathe. With the castings, the first stage was to lightly touch up the blades with a file before using various grades of emery paper. They were polished with a mop and chromium oxide polishing medium. Then the handling extensions were machined to 4.5 diam spigots to fit their corresponding holes in the bosses. Machining left a 1mm thick circular flange at the base of the blades. This housed the bolts securing the blades to the boss. The drawing called for more than the six bolts I used, but adding them would have been too difficult.

Marking out also would have been difficult and time-consuming, as eight flanges required attention. I, therefore, made up a circular plate jig to sit over the 4.5 diam spigot. With this clamped to the flange, one hole was drilled and located with a fitted pin before boring the other five. **Fig. 12-3** shows the blade held between rubber vice jaws

and steadied with Spenser Wells forceps. Whilst drilling these small holes, it is difficult to know when break-through will occur, at which point you reduce pressure on the drill bit. To ease the shock of break-through and protect the drill bit from snapping, place a piece of PVC sleeving on the drill bit against the chuck.

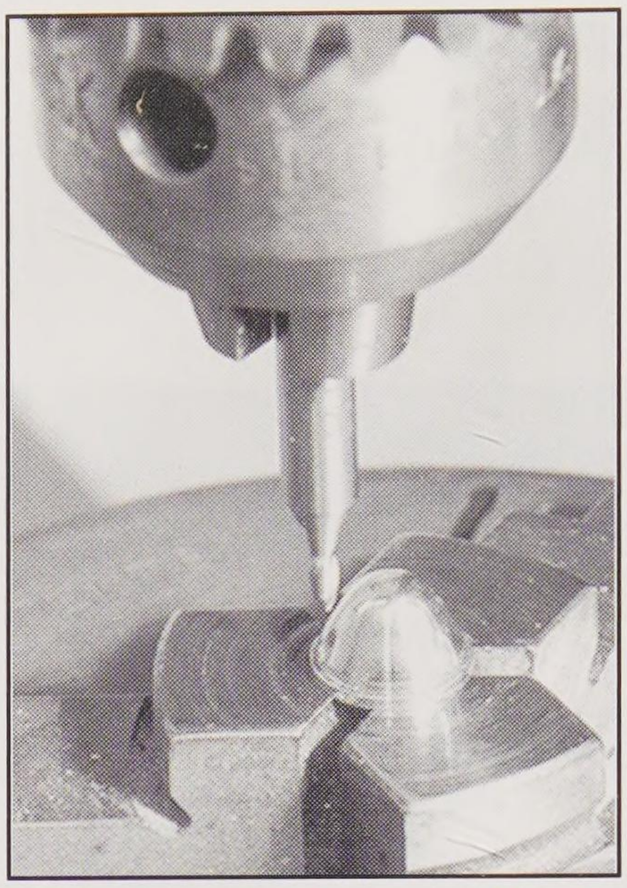


FIG. 12-4: Machining in the fixing screw counterbores on the exit cone.

Each pattern was comprised of a flange and blade soft soldered together. Casting, however, eliminated any soldering on the final propeller, as grey solder on a bronze fitting was unwanted.

The exit cone was a straightforward turning job. I had a circular form tool to finish off the semi-spherical point after machining the taper. Then I bored the fixing bolt holes (they cut into the cone) using a 1.8 diam slot drill in the vertical mill. The job was held in a three-jaw chuck fixed to the rotary table (**Fig. 12- 4**). The cutter was fed in very gently owing to the severe side loads imposed on the thin slot drill.

Assembly

Fig. 12-5 (c/s) shows a complete set of parts for one propeller. Note that the "handling" boss has been machined to produce a flange and locating spigot. A check was made to ensure all the blades

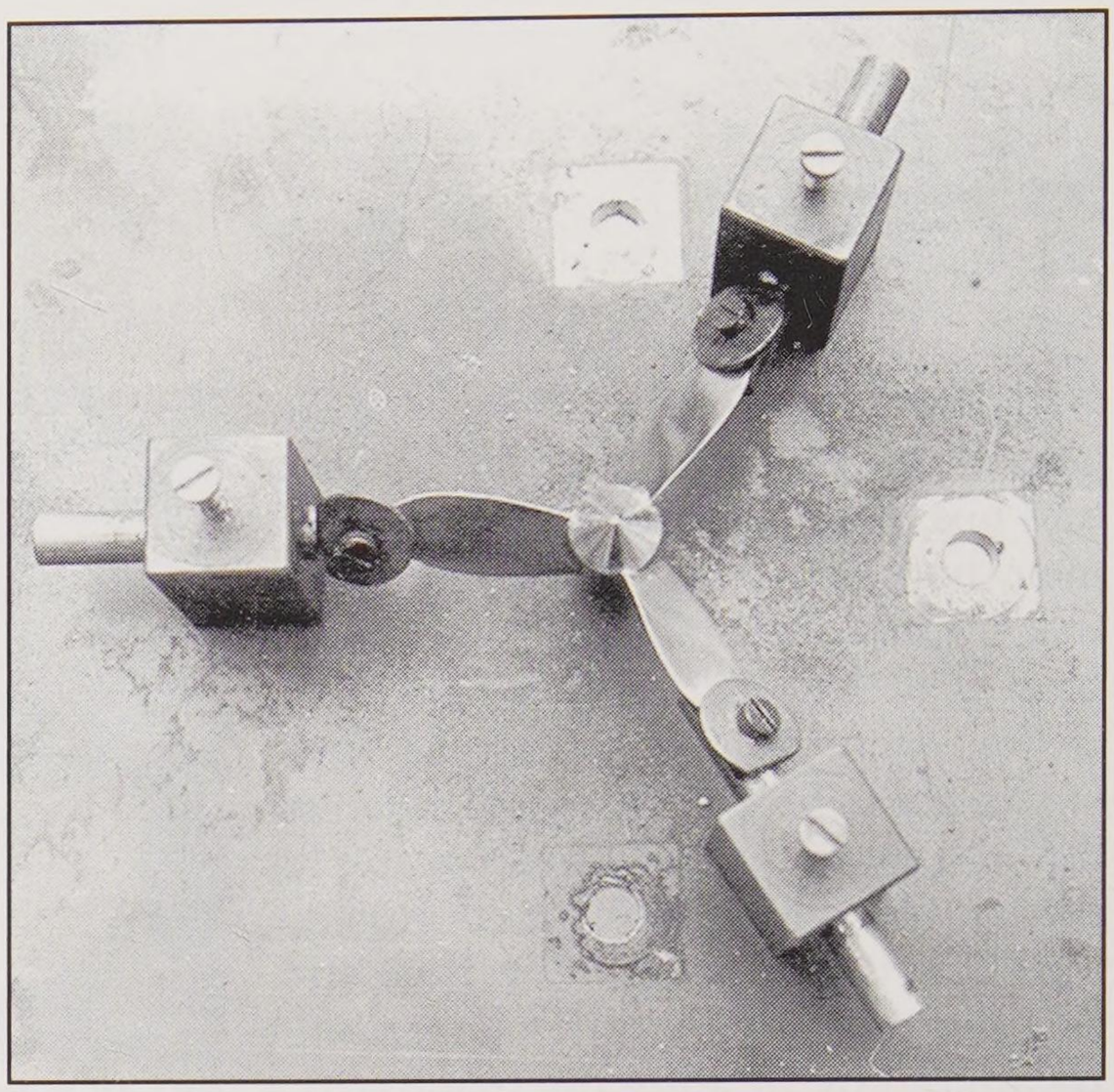
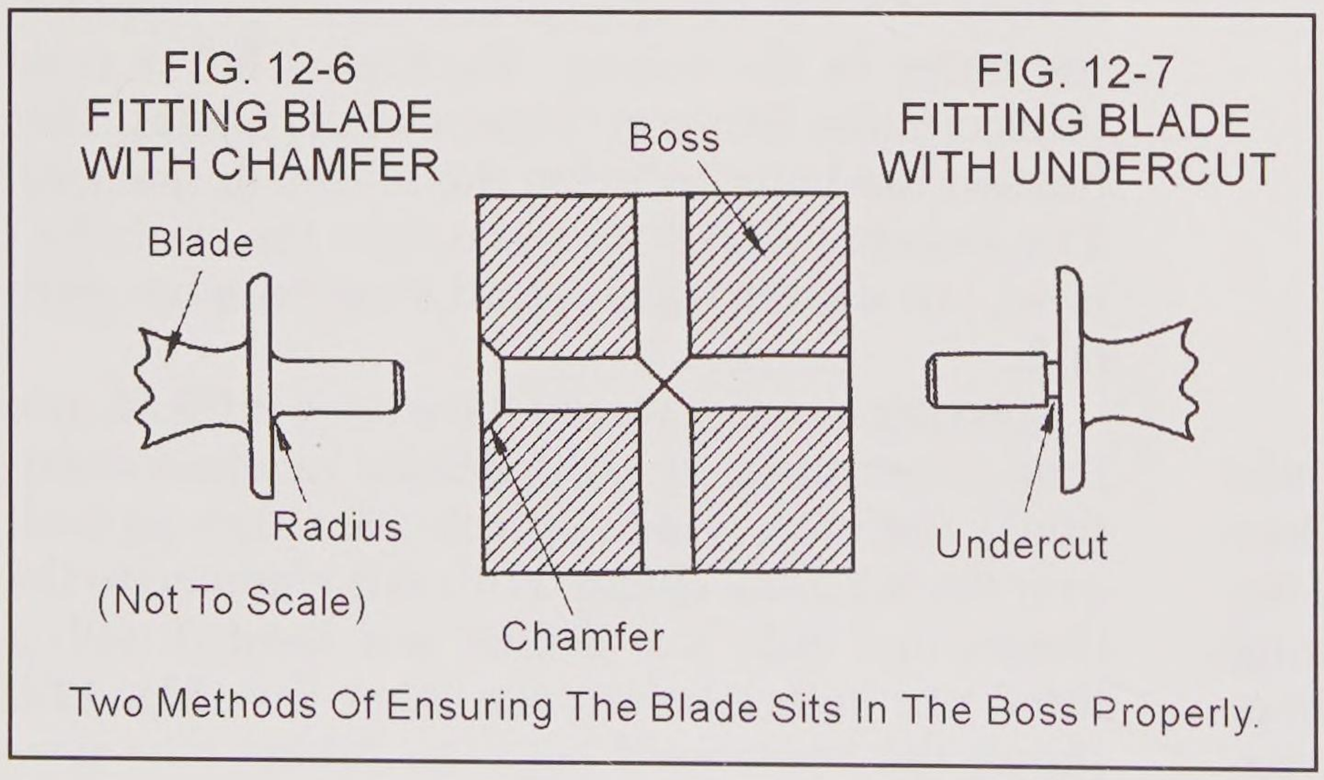
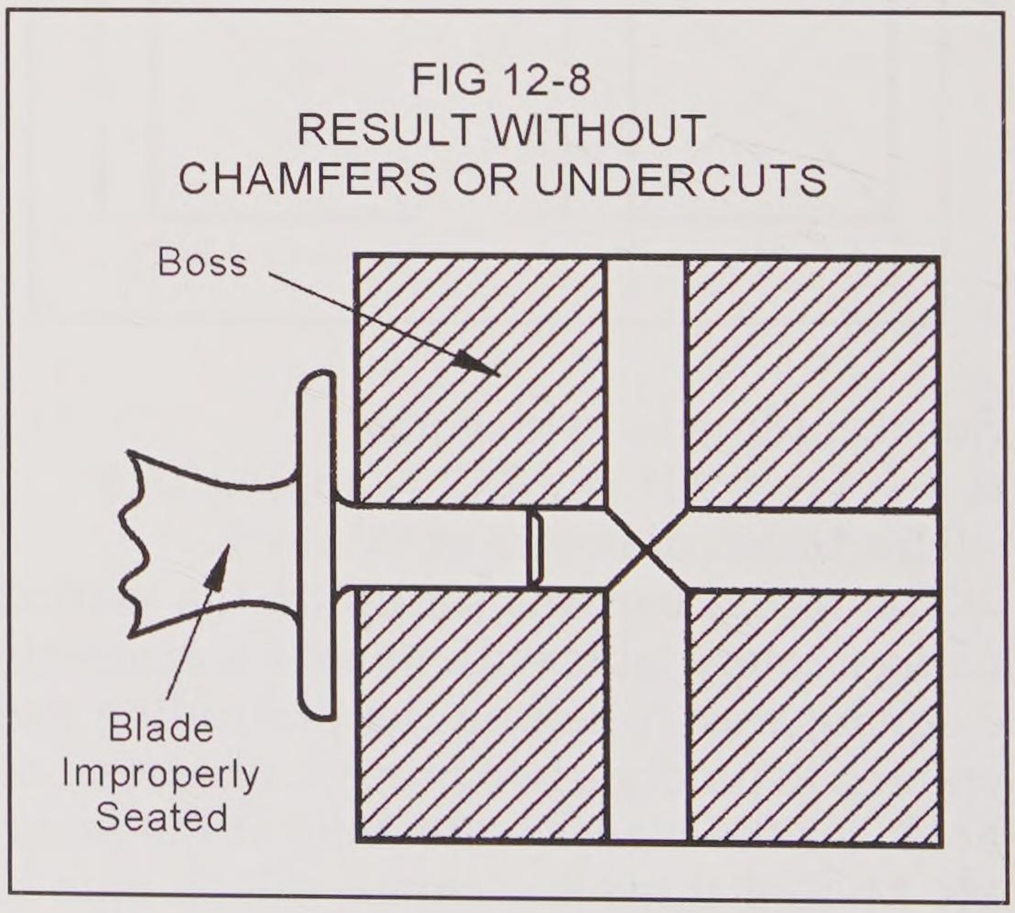


FIG. 12-9: Propeller fixture.

sat in their respective holes properly with their flanges tight against the boss faces. This required chamfering the holes slightly to accommodate the inevitable radiuses left between flange face and spigot (**Fig. 12-6**). An alternative would have been to machine the spigots with an undercut at the flange face to eliminate the radius (**Fig. 12-7**). If not done, **Fig. 12-8** is the result. This seemingly small attention to detail is necessary if a proper job is to be made of such items.

Some years ago I made a fixture (**Fig. 12-9**) for assembling three- and four-bladed props. It had clamps to locate the blades in their correct posi-





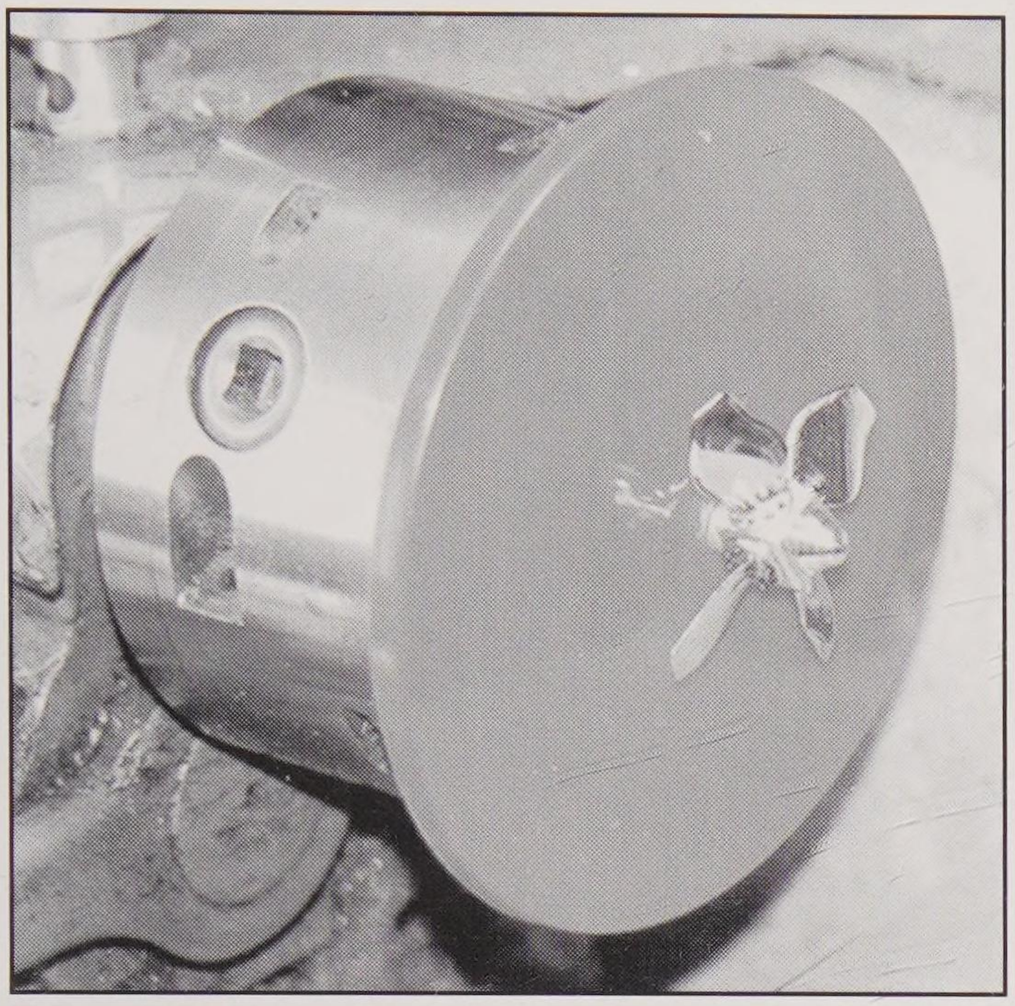


FIG. 12-10: Setup for spraying the completed propeller with lacquer.

tion and at the correct angle. As I could not find this, I did it the hard way. Since the propellers were nonfunctional, Araldite was used to attach the blades, exit cone, and stainless steel shaft to the boss.

After assembly, the simulated bolts in the flange holes were added. They were supposed to be brass wire, but short lengths are extraordinarily difficult to cleanly part off with either a

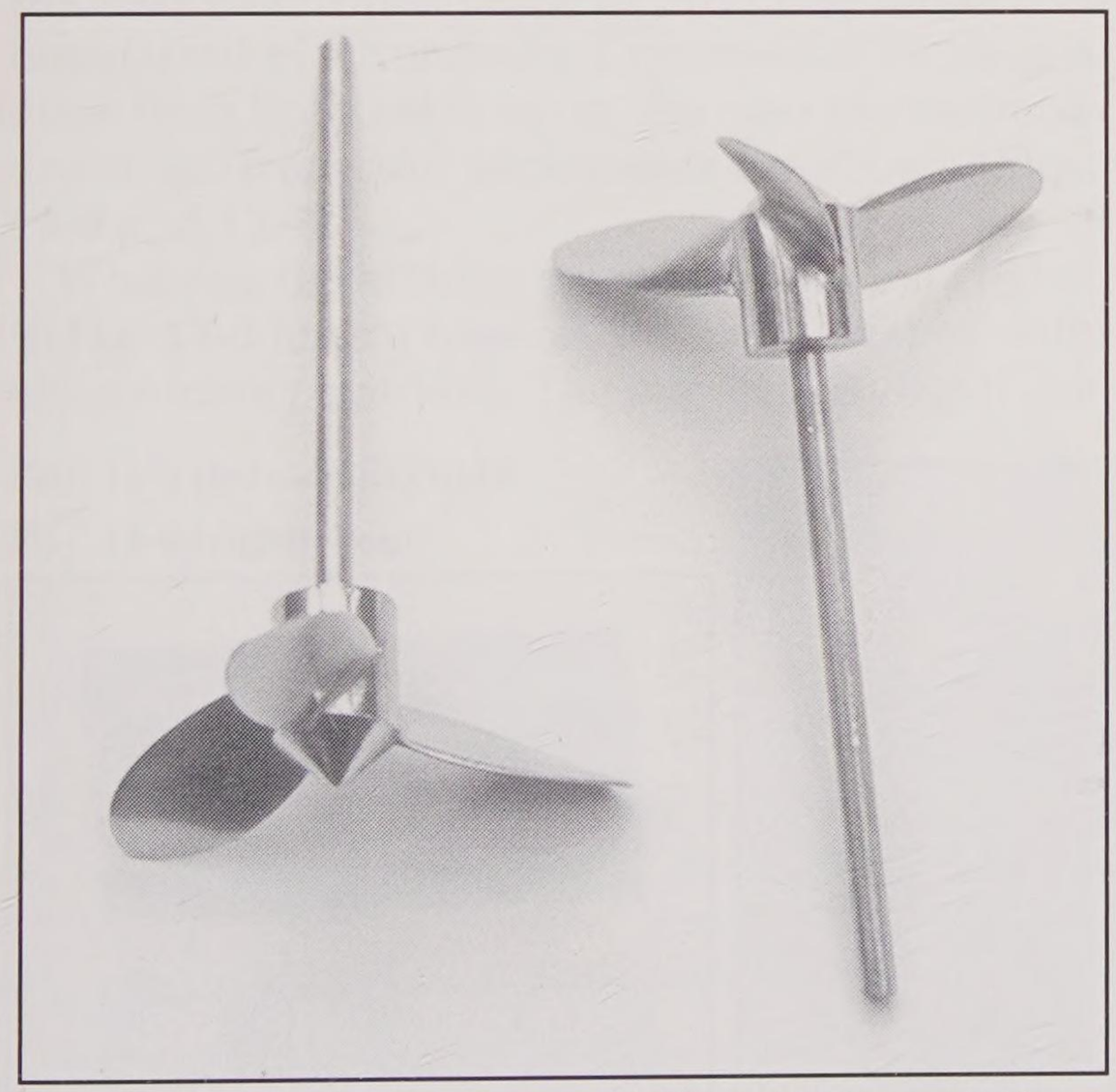


FIG. 12-12: Set of propellers made for *HMS Devastation*.

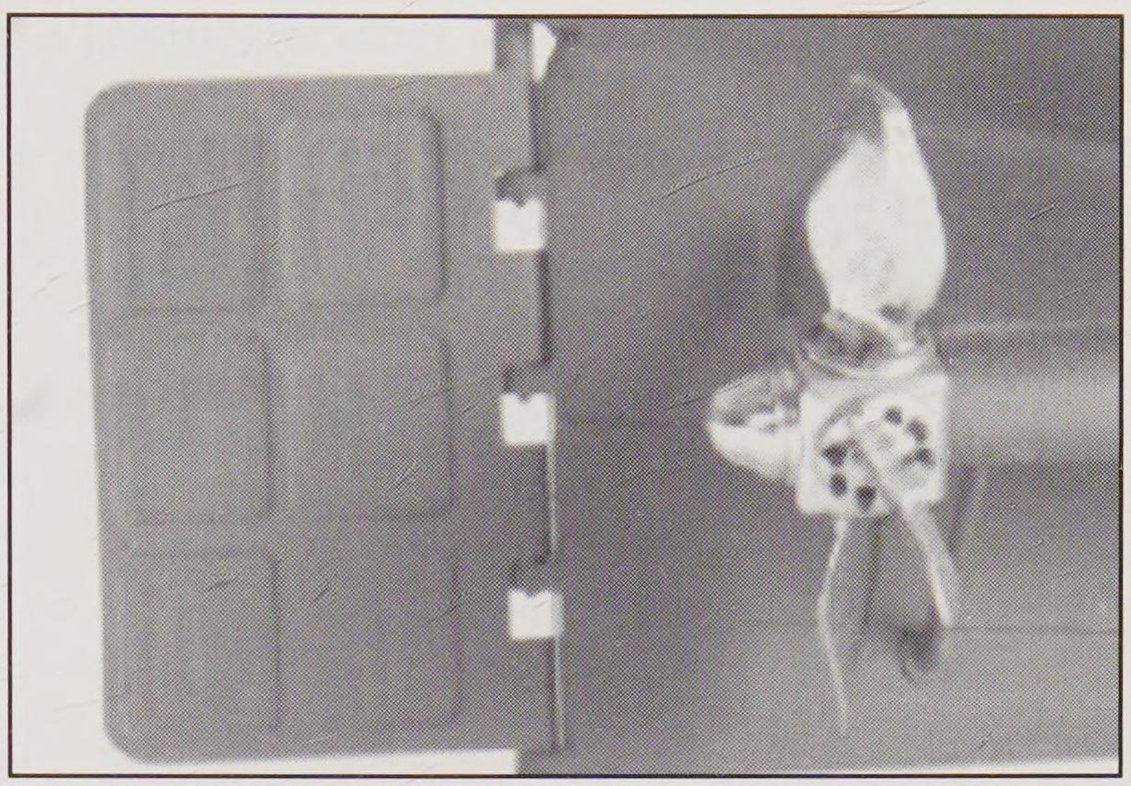


FIG. 12-11: Finished propeller fitted to *Duilio*.

parting tool or an abrasive wheel. You always end up with a "pip" that prevents the bolts from sitting properly. In the event, short lengths of black PVC wire were substituted, as this can be cleanly cut off with a scalpel.

A final cleanup was required before lacquering. White spirit was used to remove the polishing compound followed by methylated spirit. Lacquering was done in the lathe with a plastic lid covering the three-jaw chuck and cardstock protecting the bed. Run the lathe at its slowest speed; otherwise, centrifugal force will ensure a blob of lacquer on each blade tip. Only a short burst of aerosol is required, but apply two coats to ensure the whole assembly is covered (**Fig. 12-10**).

Fig. 12-11 shows the propeller finished and fitted to *Duilio*. **Fig. 12-12** shows a set of propellers made for *Devastation*. These were made with separate blades soldered into the boss. No attempt

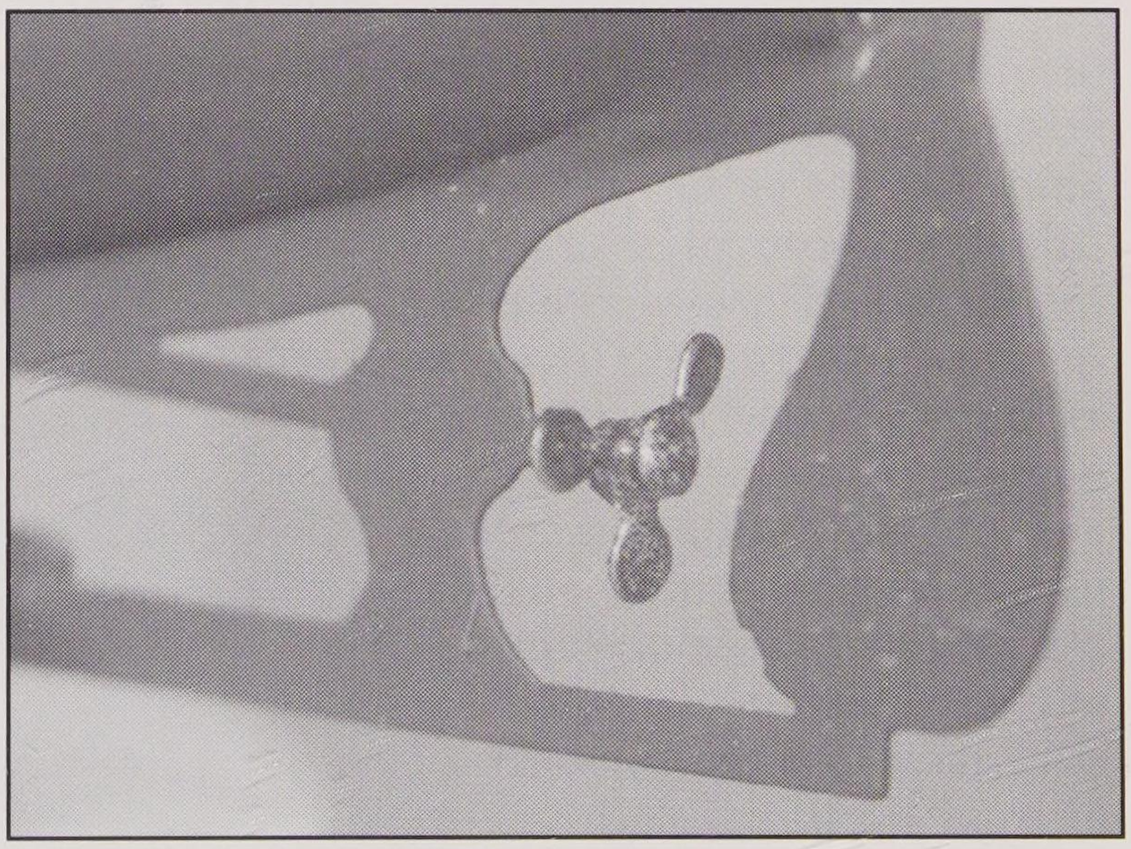


FIG. 12-14: "Wire" propeller on *Duilio's* steam pinnace.

was made to streamline the boss. *Victoria's* fitted propellers are shown in **Fig. 12-13** (c/s).

Advanced Ship Modelling described a method for making minute propellers from thin fuse wire. I will not repeat it here. One can be seen on *Duilio's* steam pinnace (**Fig. 12-14**).

The torpedo boat *Duilio* carried internally had a propeller. It was too large to make out of wire and, furthermore, it appeared to have only two blades. This was made by turning a boss and shaft, then cutting a 0.008" slot through the boss with a slitting saw. The two blades were made as one piece and soldered into the slit (**Fig. 12-15**).

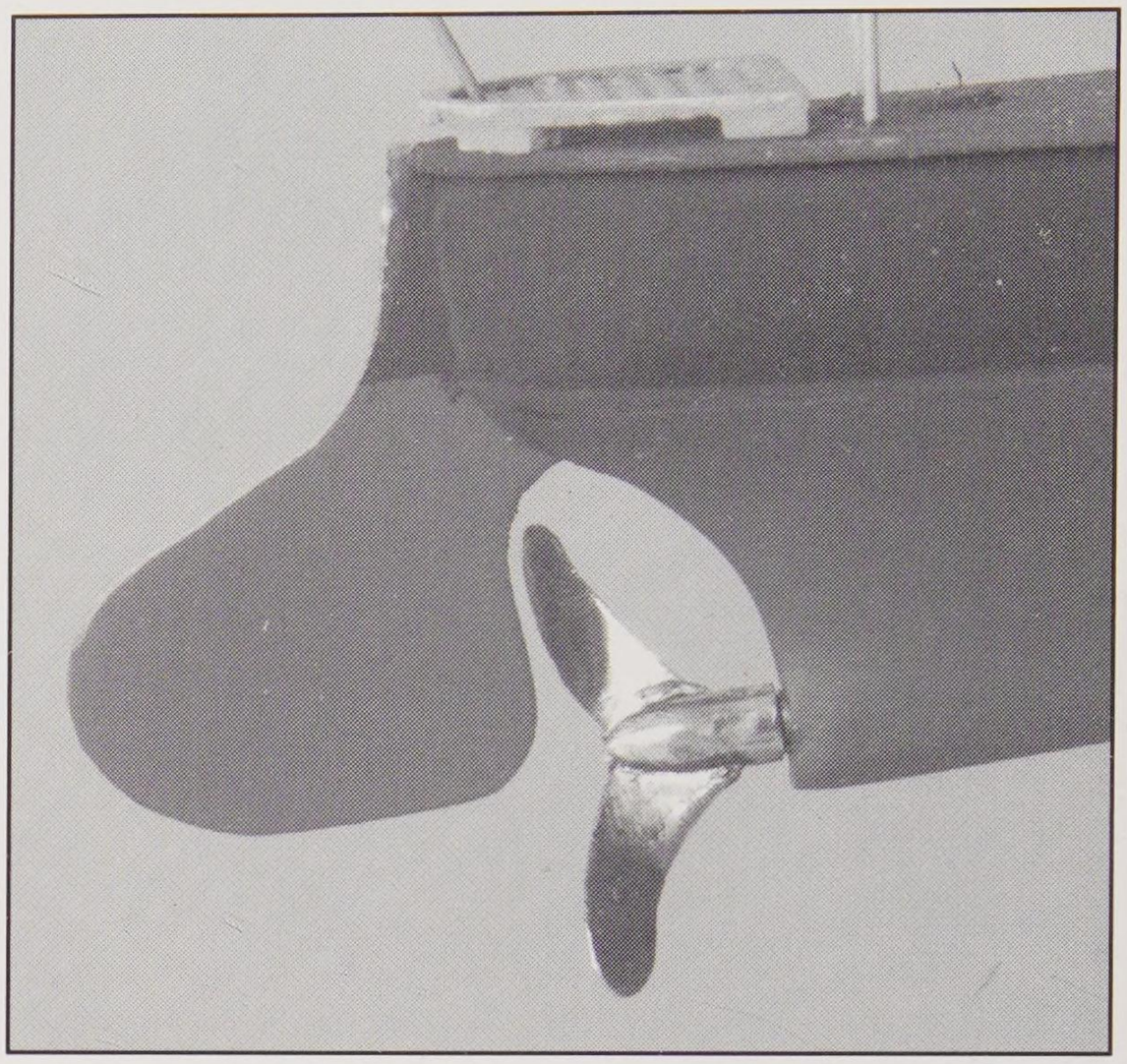
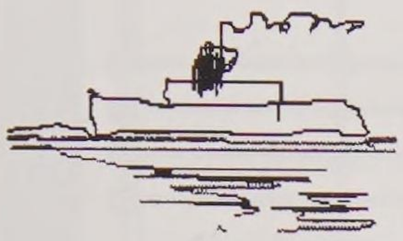


FIG. 12-15: Brass propeller on torpedo boat.



Chapter Thirteen

Photo Etching

The warships in this book contain many photo-etched components designed and drawn by the author. I do not do the etching, as this is better left to commercial houses, because they have the experience and equipment. (You can tackle it yourself – and I have – but the results are inferior.) It also saves you storing and working with aggressive chemicals that are used only occasionally.

The process described in my two books, *Advanced Ship Modelling* and *Photo Etching* (coauthored with Azien Watkin) enables pieces of great delicacy, detail and, where required, repetition to be produced. The first batch of drawings for *Duilio* (BK130) contained 18 A4 sheets, nine each in negative and positive modes. These were drawn using a CAD (computer aided design) programme, enlarged 200% (twice full size), and sent to the etcher as hard copy. Electronic transfer was not too successful at that time, so colours were used to denote the fronts and backs of the drawings.

The following pages contain examples of these drawings. **Fig. 13-1** is in negative mode and **Fig. 13-2** is in positive mode. The second batch (BK131) was drawn using a CAD programme and transferred electronically. Commercial etching is done from both sides so, in the case of computer drawings, front and back sheets are shown (**Figs. 13-3** and **13-4**).

What can the etching process do? The skylights in **Fig. 13-5** have a base of "smoked" Perspex with brass etching overlays. The guarded skylights are

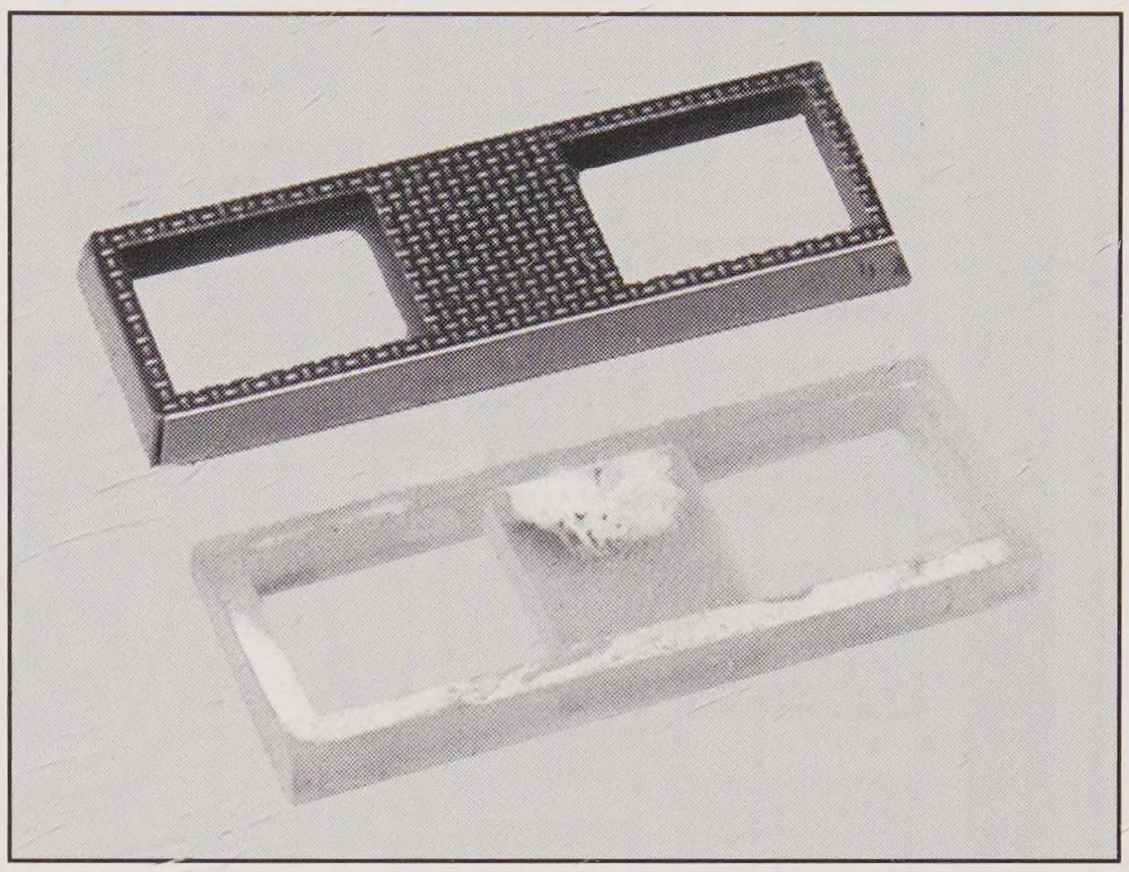


FIG. 13-7: Coamings.

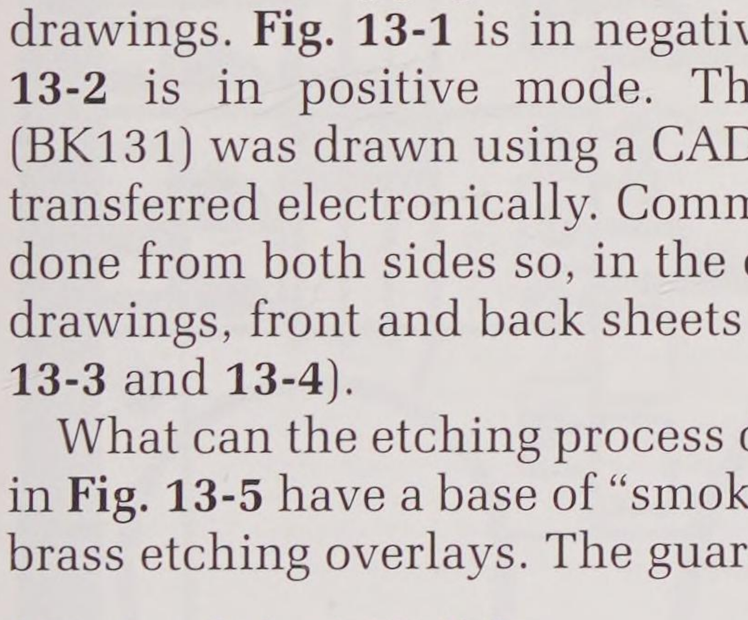
glued to the frame which in turn is fixed to the Perspex. The vent housing in **Fig. 13-6** has etched pieces glued to a wood foundation. **Fig. 13-7** shows two types of coamings. The top one is a folded etching with the corners soldered (if required). The bottom one is made of Perspex. The advantage of the etched one, as can be seen, is that a chequer-plate design can be half etched in. Note that the sides of the coaming are at a slight angle. This must be catered for in the etching drawings.

Ship's wheels

Fig. 13-8 illustrates photo etching's ability to provide numerous identical parts. This is done by using either a stepping camera to produce multiple images of a component or, if the artwork is computer derived, by "rubber stamping" (the name given to repeating the image). The computer's ability to reproduce exact copies is a great advantage over the drawing board, where exact repeatability is hard to achieve.

FIG. 13-5 (below): Skylight.

FIG. 13-6 (right): Vent.



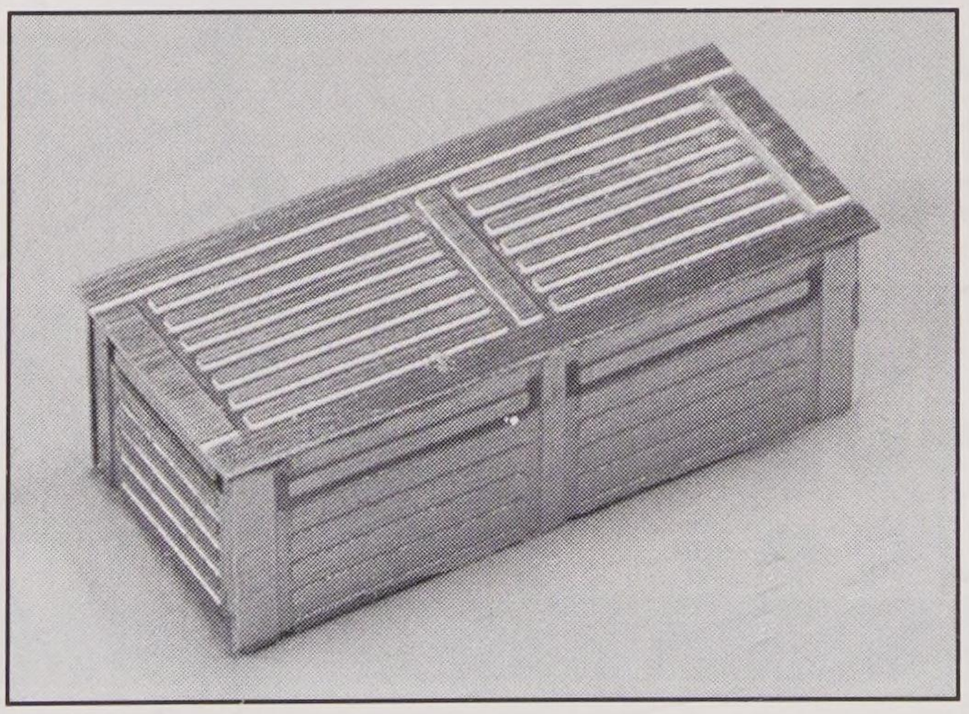


FIG. 13-1 NEGATIVE MODE

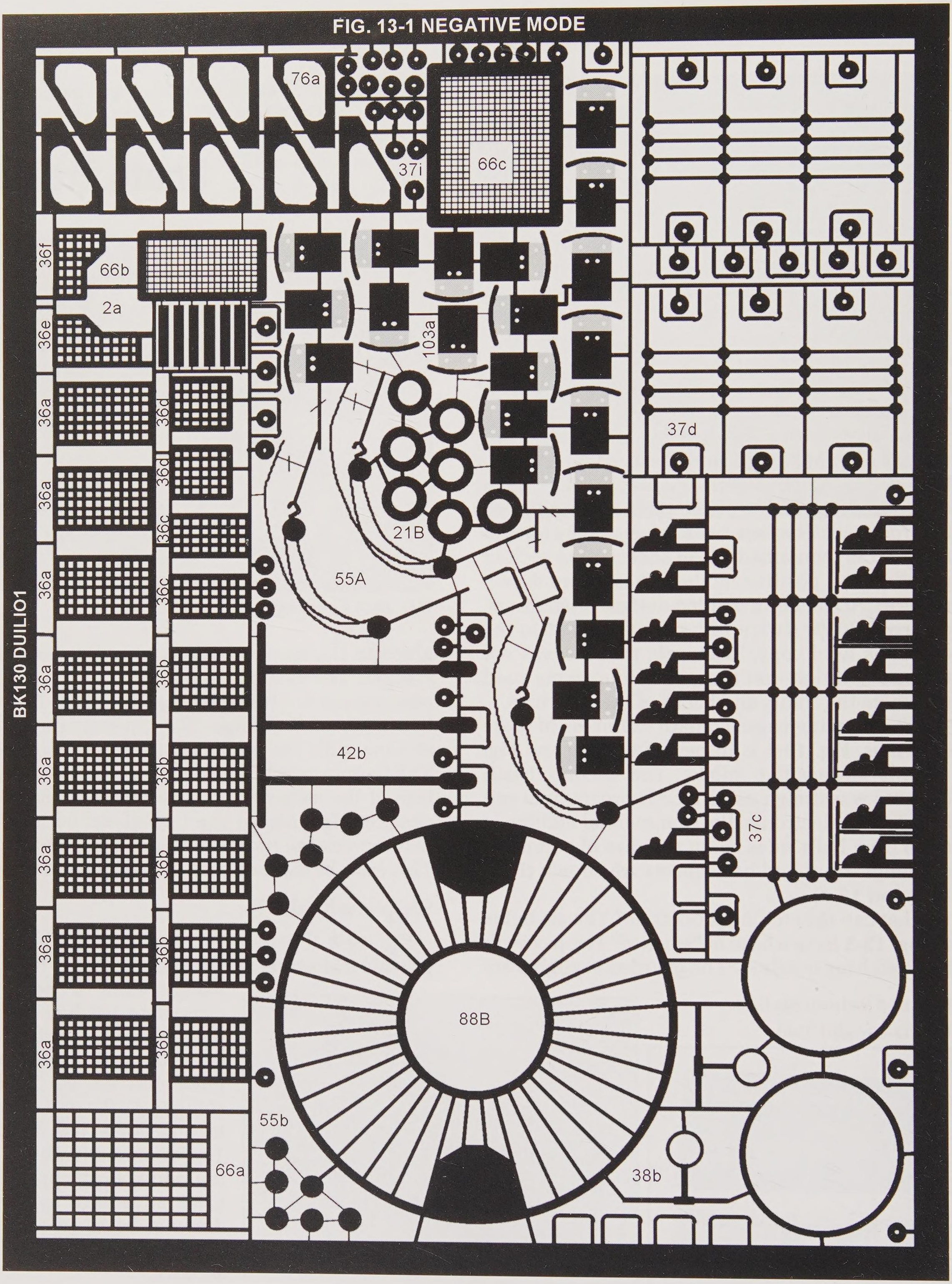
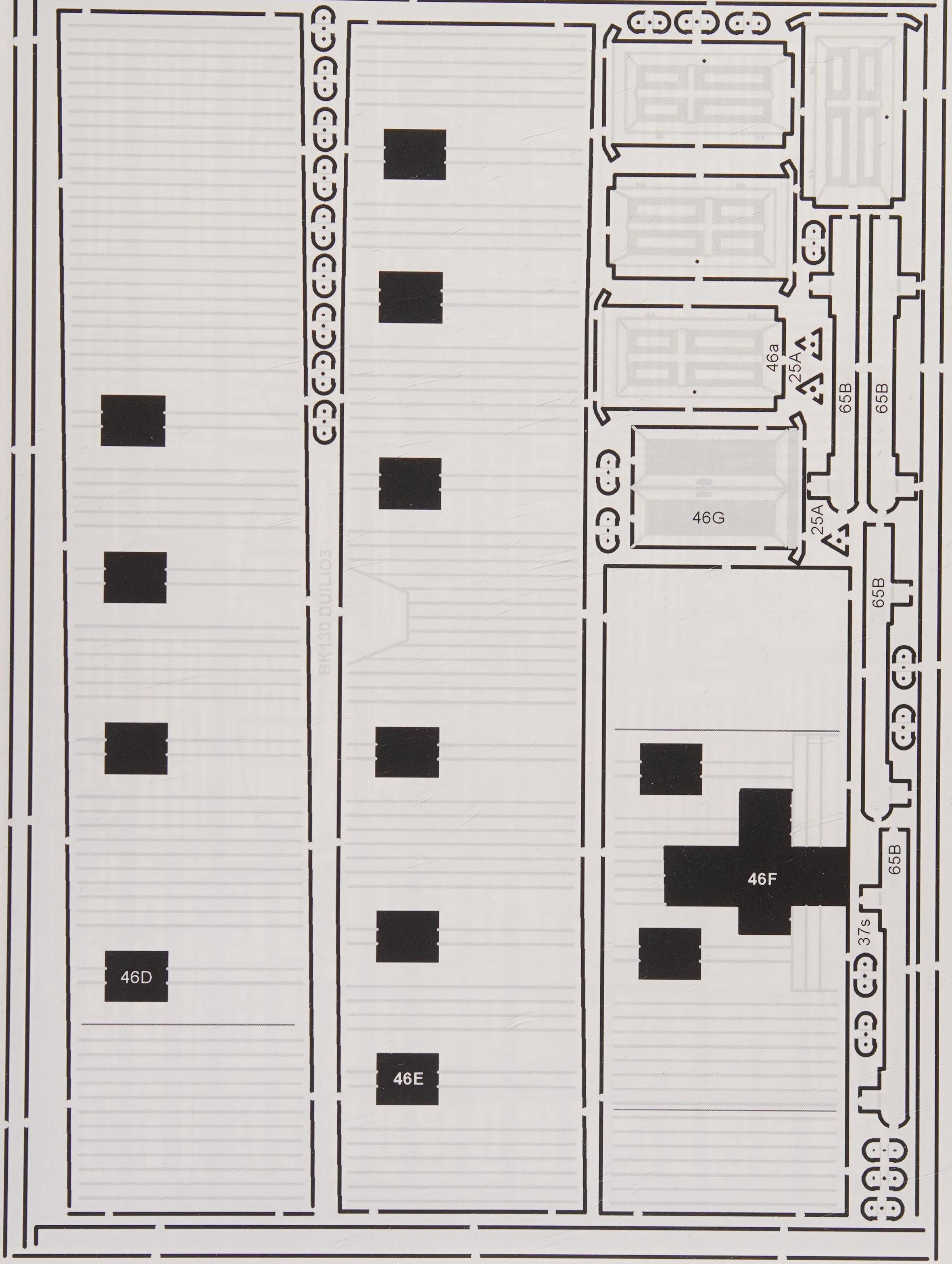


FIG. 13-2 – POSITIVE ETCHING DRAWING



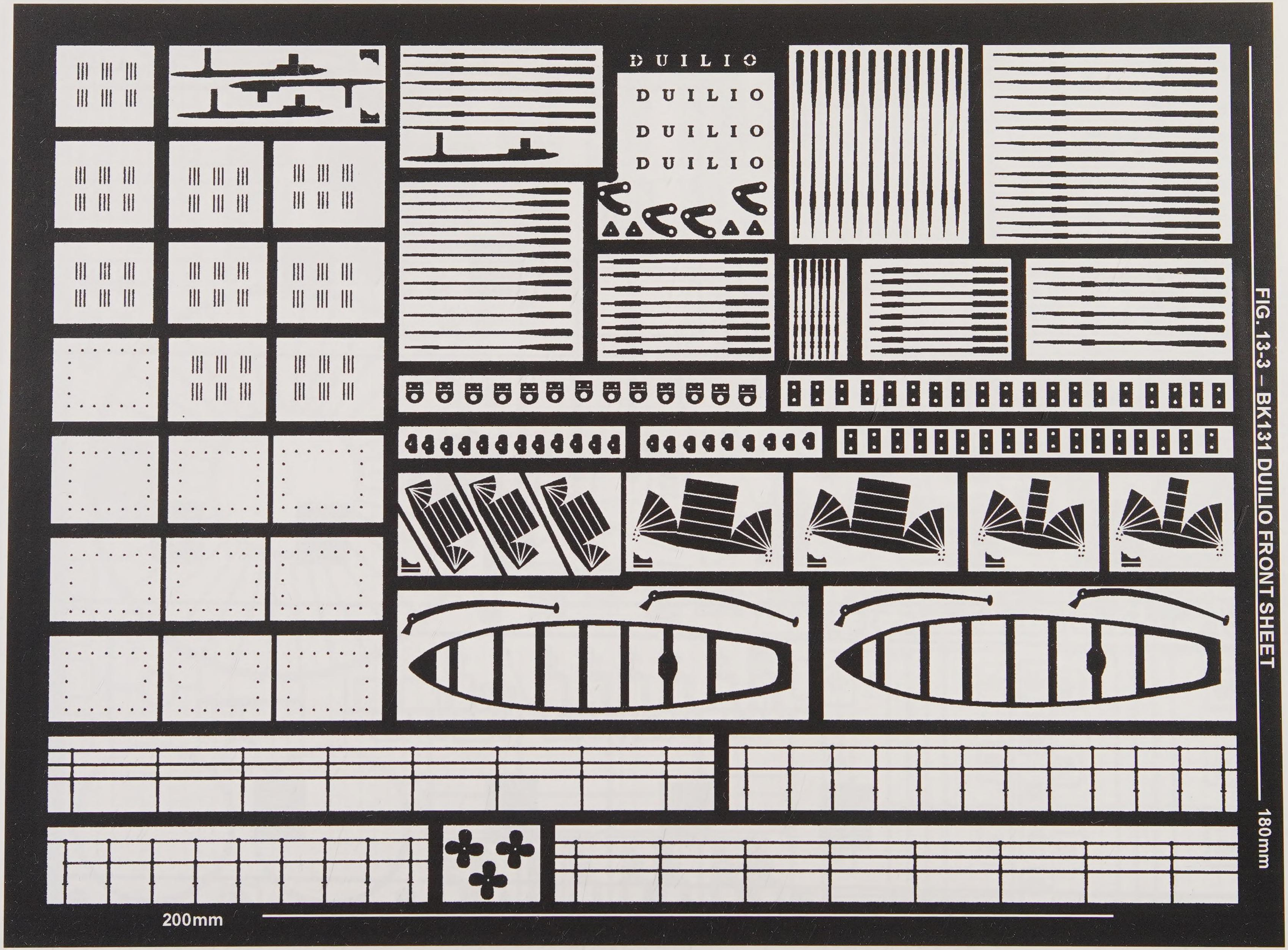
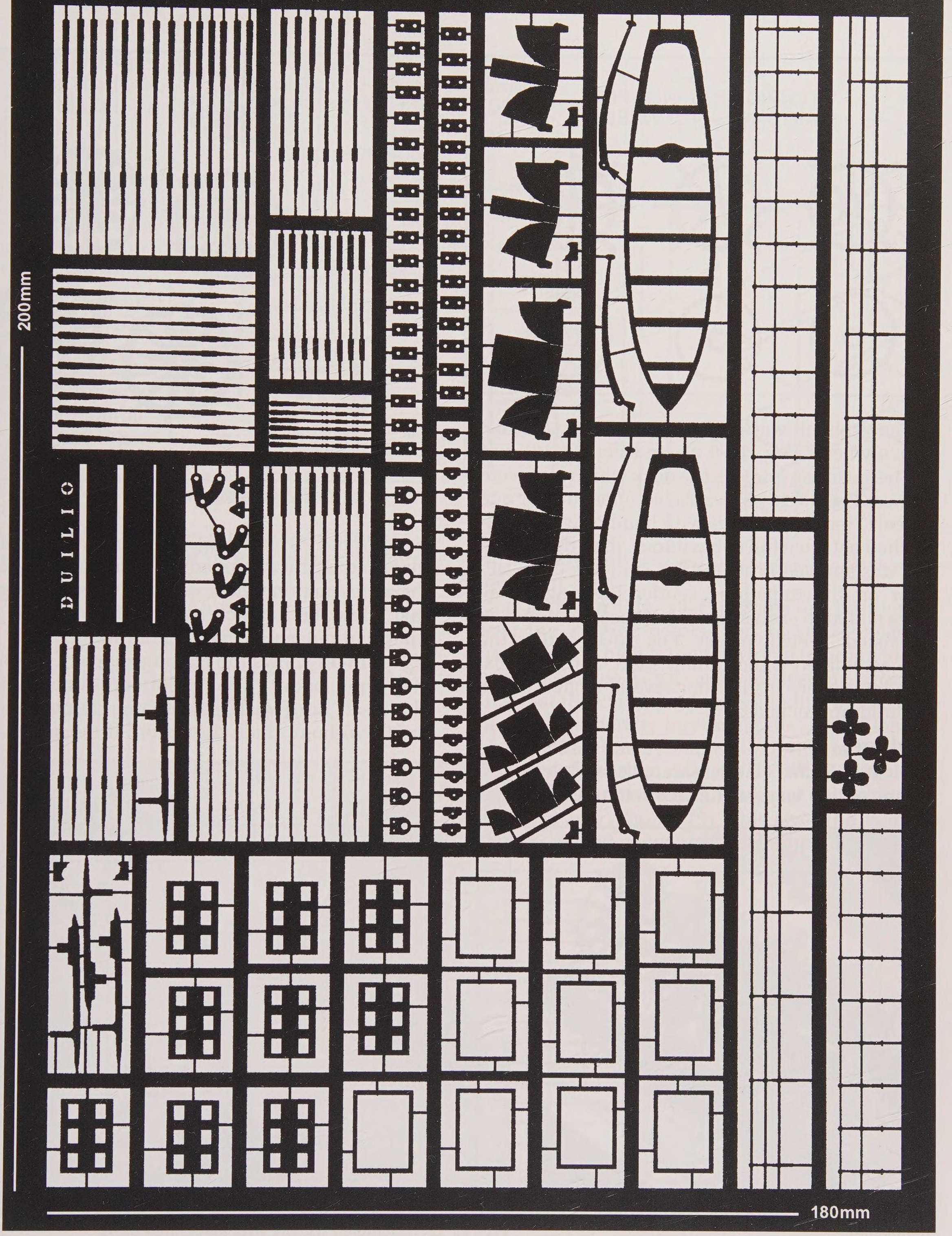
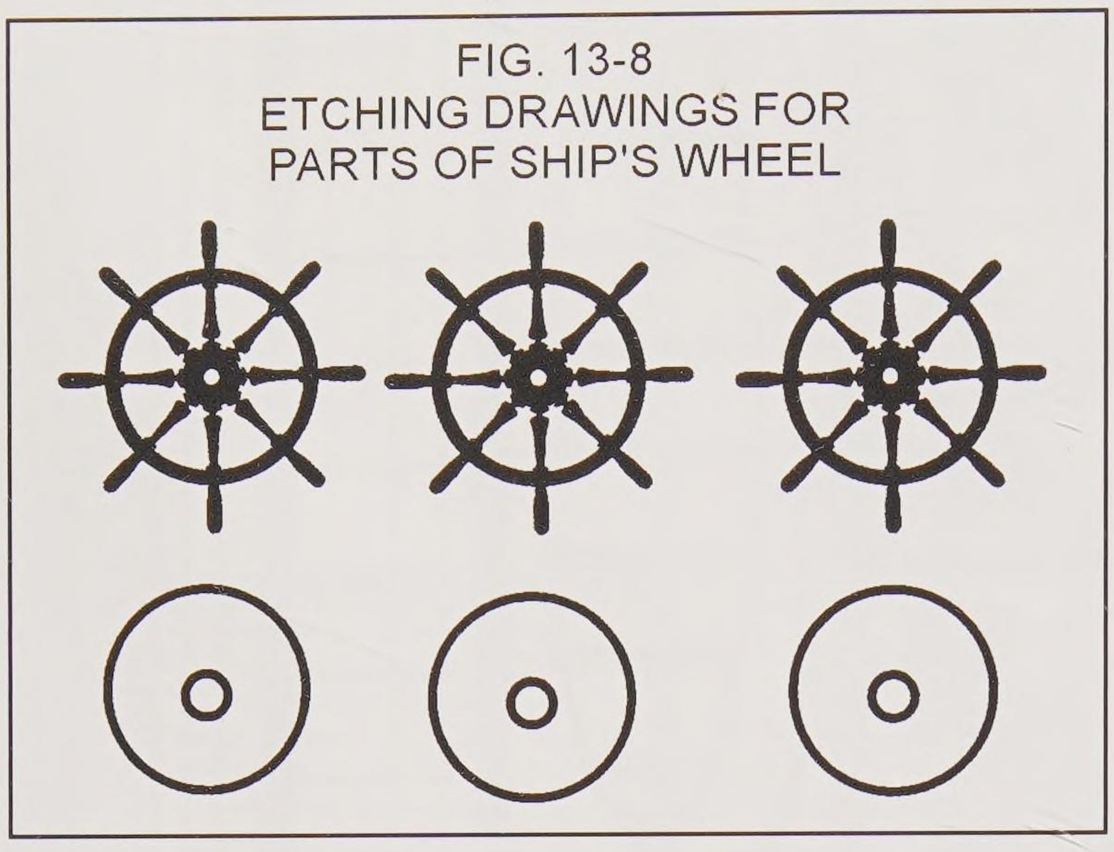


FIG. 13-3 – BK131 DUILIO FRONT SHEET

FIG. 13-4 – BACK SHEET BK131





The problem was to produce not only the five ship's wheels (**Fig. 13-9** c/s and **Fig. 13-10**), but the helmsman's grids on the deck which also were etched. **Fig. 13-11** shows the components for one wheel. The two etchings with handles were sandwiched between the two without, then the assembly was sprayed brown. After spraying clear lacquer on the unpainted reinforcing rings, they were added to each side of the wheel, which now consisted of eight pieces. **Fig. 13-12** shows the five assembled wheels, their shaft, and brackets. The latter were made from several etched layers to build up thickness.

Ladders

Most of *Duilio's* ladders were constructed in one of two ways using brass etchings de-

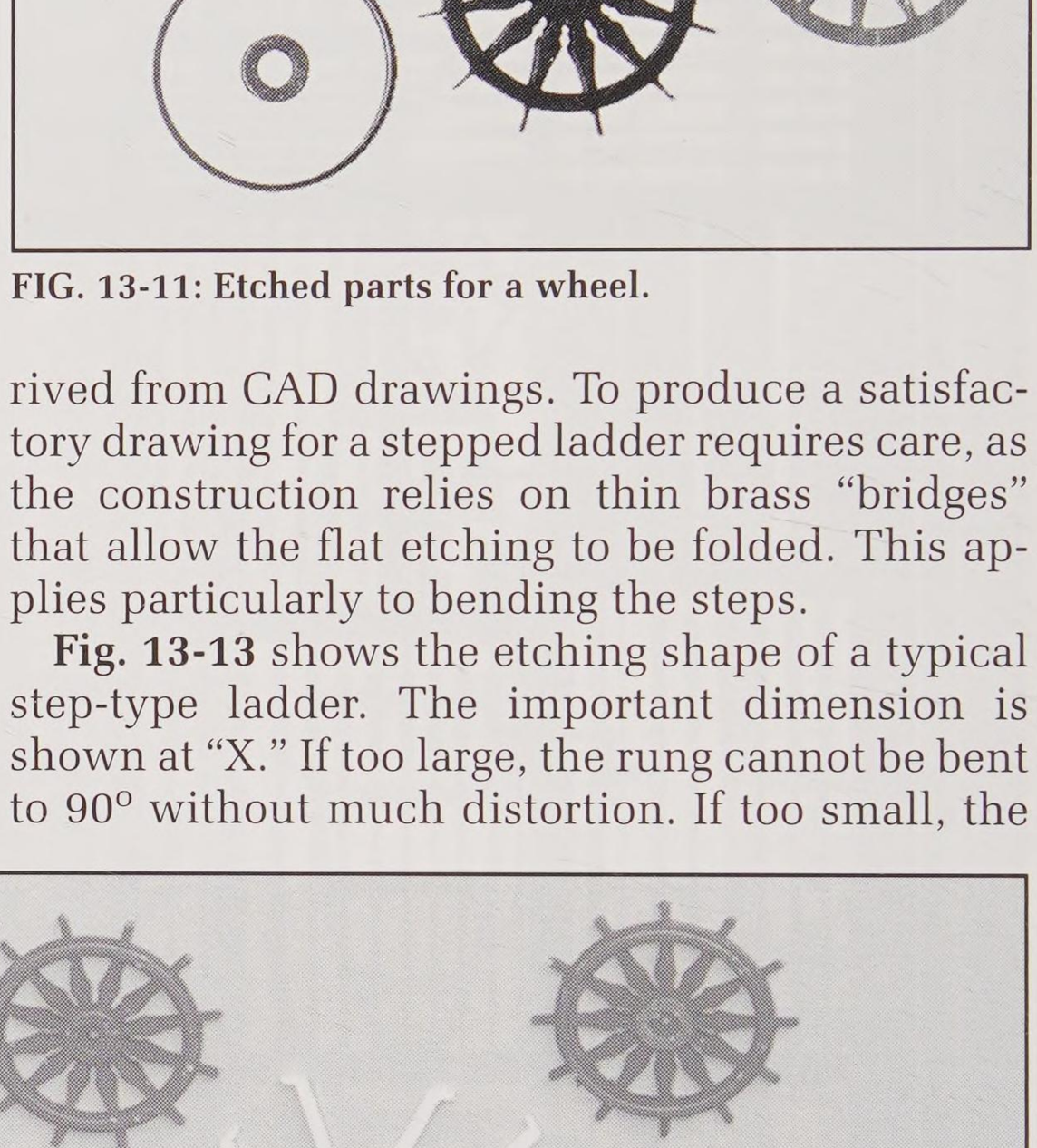


FIG. 13-11: Etched parts for a wheel.

rived from CAD drawings. To produce a satisfactory drawing for a stepped ladder requires care, as the construction relies on thin brass "bridges" that allow the flat etching to be folded. This applies particularly to bending the steps.

Fig. 13-13 shows the etching shape of a typical step-type ladder. The important dimension is shown at "X." If too large, the rung cannot be bent to 90° without much distortion. If too small, the

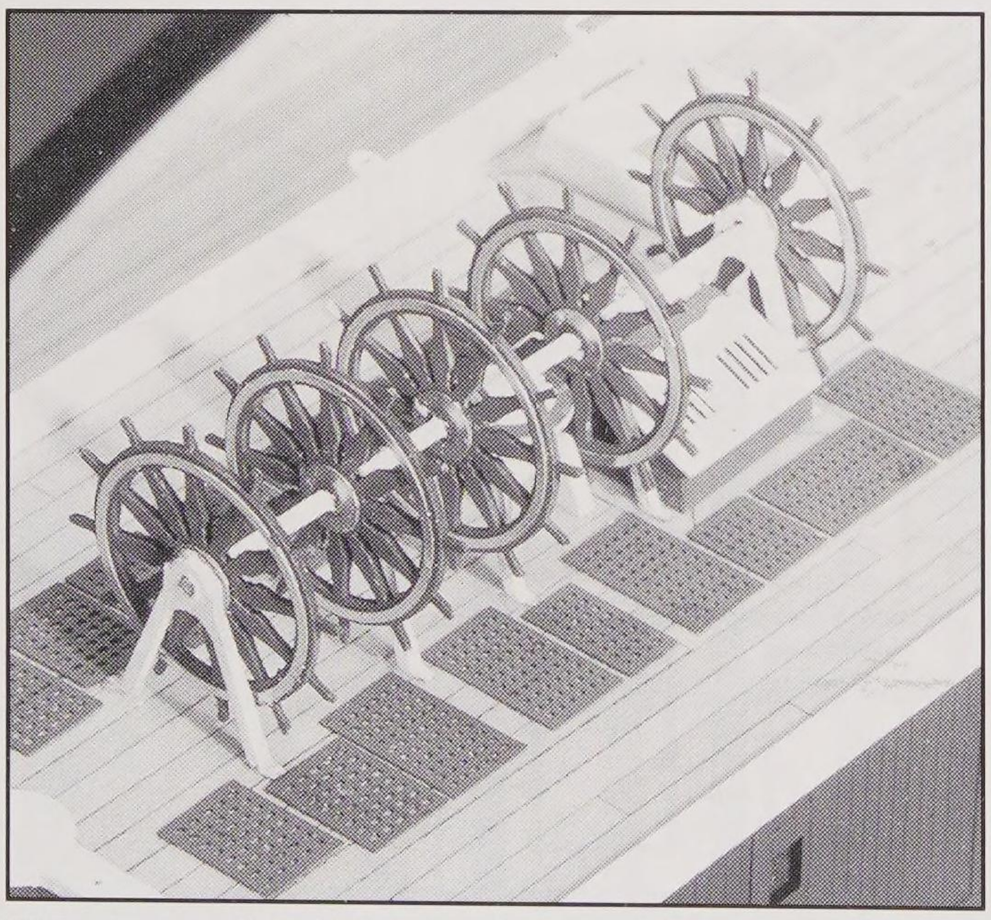


FIG. 13-10: Fitted ship's wheels with gratings for the helmsman.

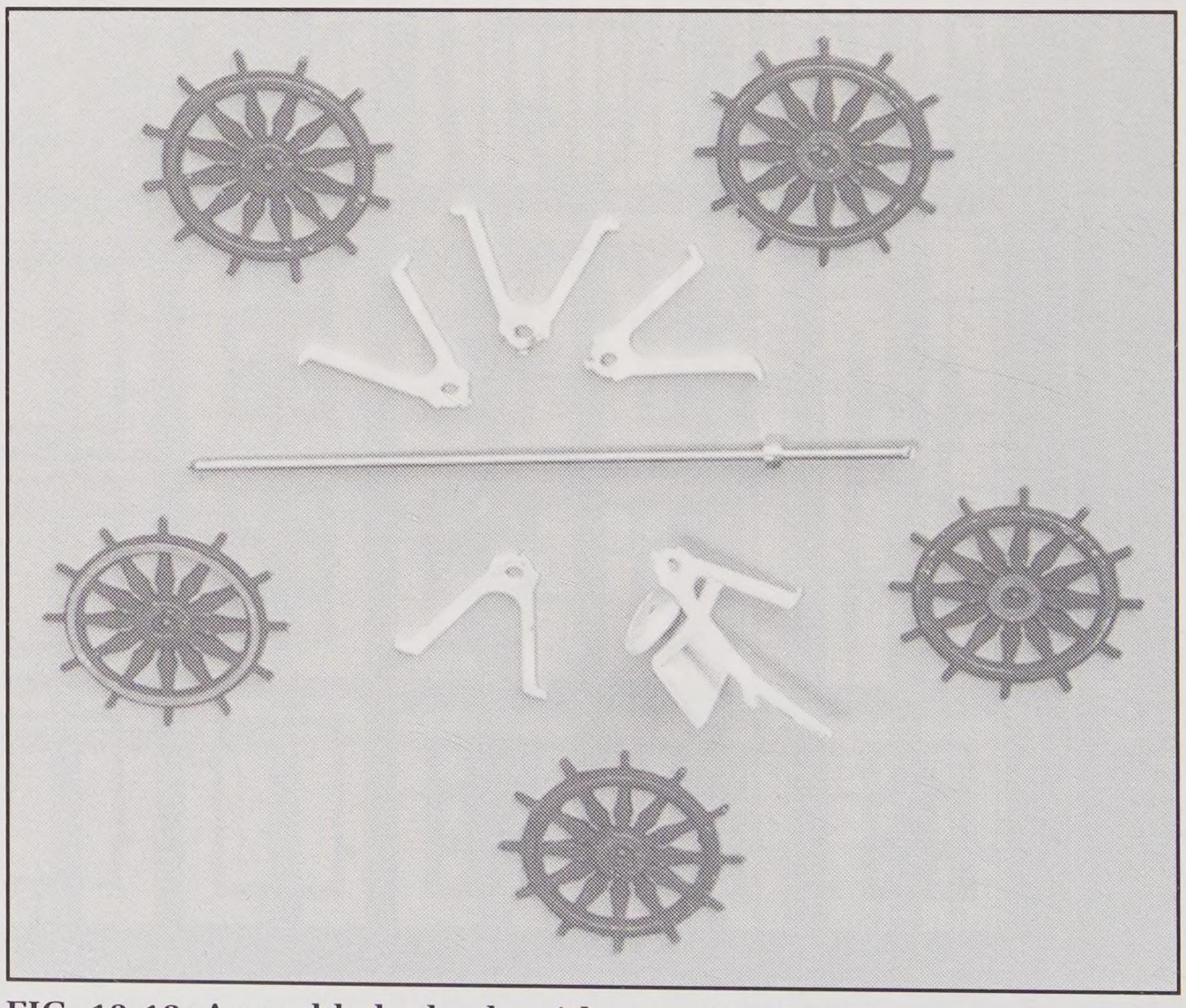


FIG. 13-12: Assembled wheels with associated parts.

danger of the ladder falling apart exists, as the hinge will break.

Fig. 13-14 shows how the flat etching is folded. The two side pieces (the stiles) are folded inward and the rungs twisted up to lie between them at the correct angle.

Fig. 13-15 is a magnified drawing of what the computer produces when using 0.8mm cutting lines. The important dimension is 0.5mm, as it forms the hinge for the step.

To construct a ladder, a grid with horizontal pitch lines is set up (**Fig. 13-16**) and one half step is drawn (**Fig. 13-17**). Steps are positioned over the locating points (**Fig. 13-18**) to create a half ladder, which is then mirrored to produce the complete shape. What can be misleading is forgetting that the computer leaves a radius on the end of the line, thereby increasing the overall length of a nominal line by the width of the line!

A way of avoiding this is to lay out the shape using parallel construction lines and filling in the enclosed area (**Fig. 13-19**). This gives the shape a square end and maintains the all-important 0.5mm

FIG. 13-13 – ETCHING DRAWINGS FOR TYPICAL STEP LADDER

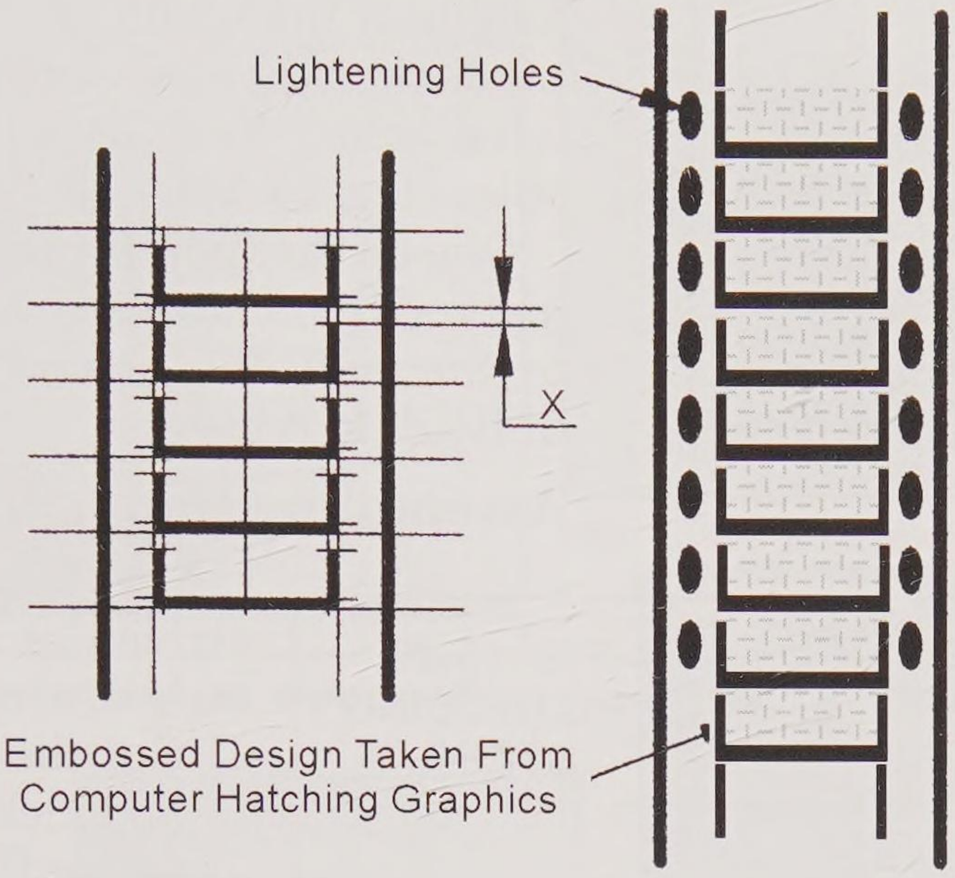


FIG. 13-14
ETCHED LADDER
FOLDED UP

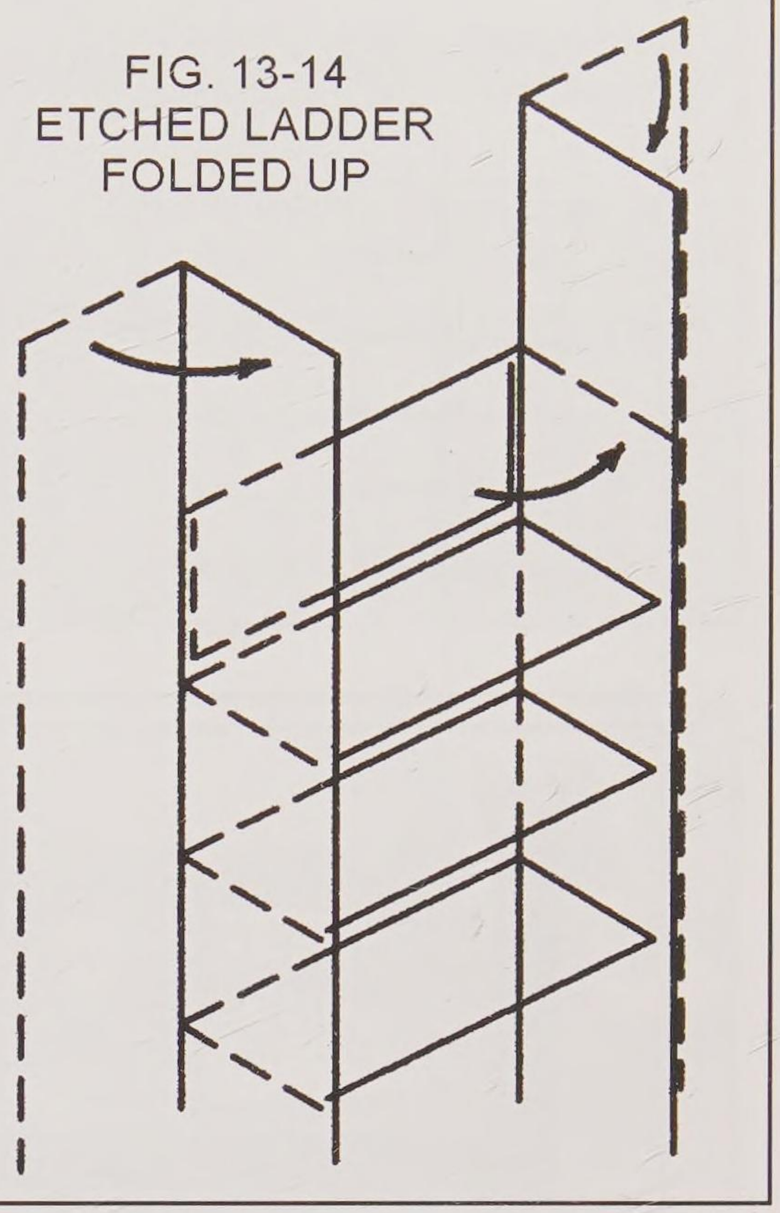
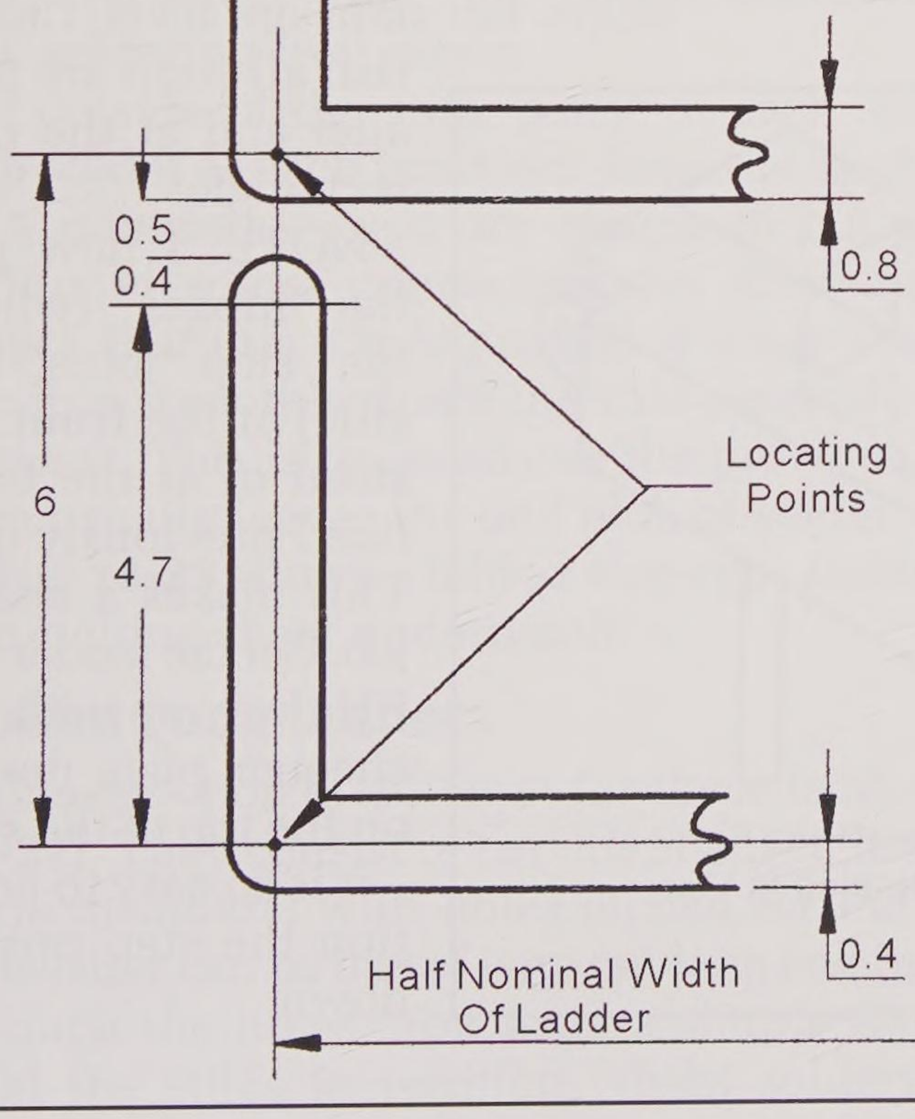


FIG. 13-15
MAGNIFIED
COMPUTER
DRAWING
(All Dimensions In MM)



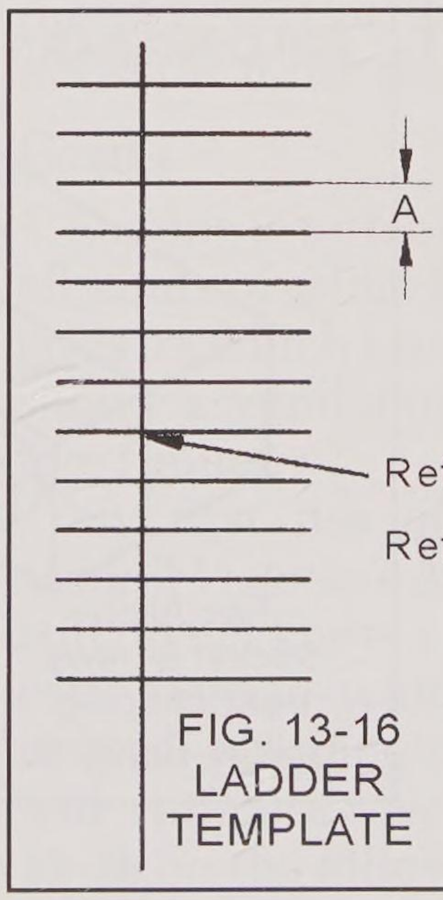
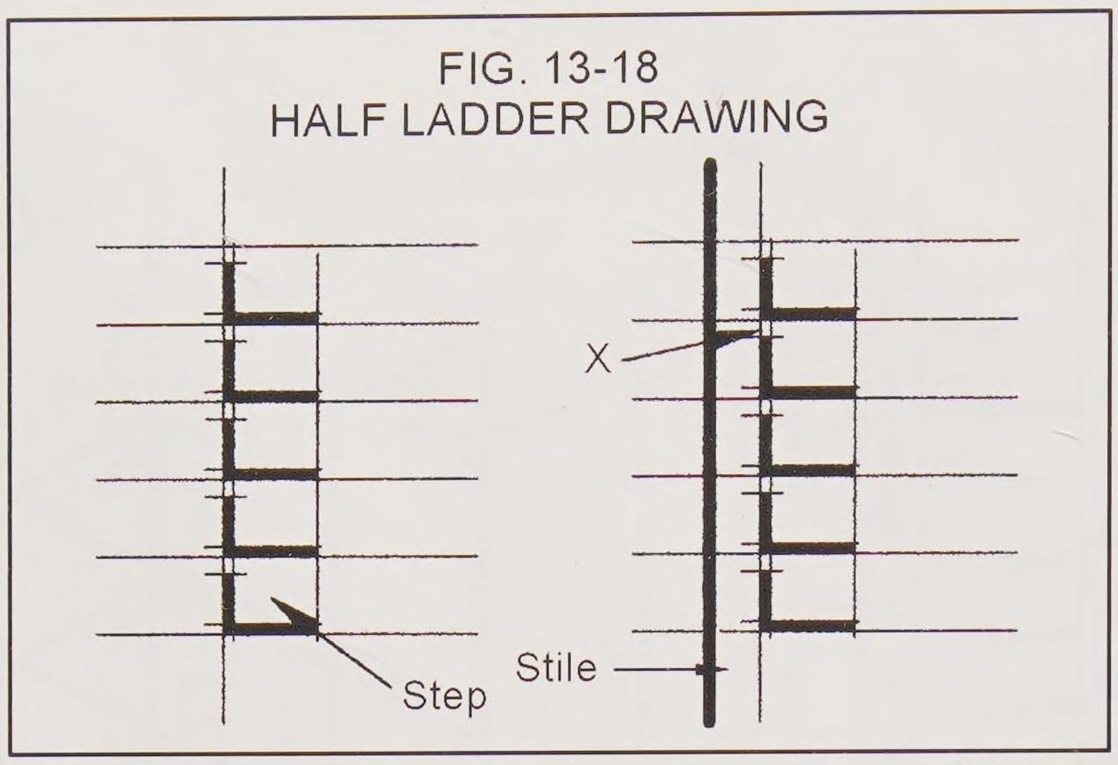
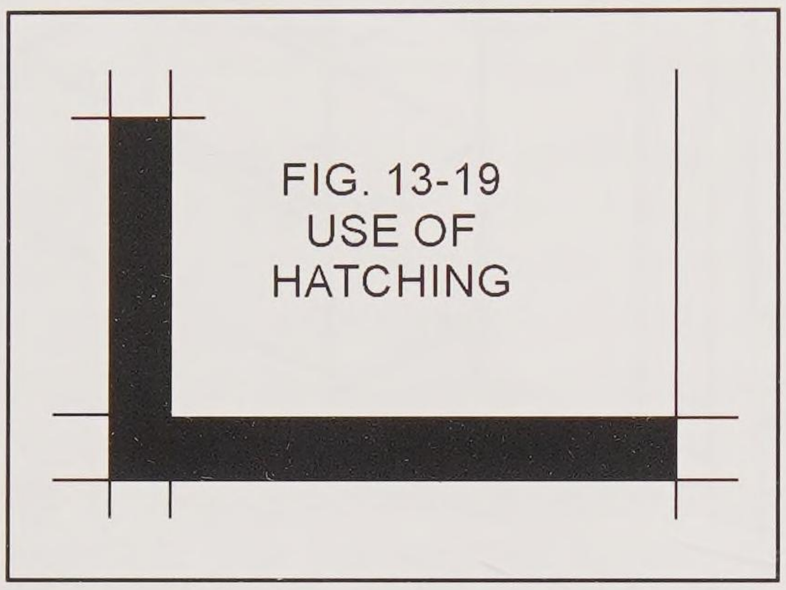
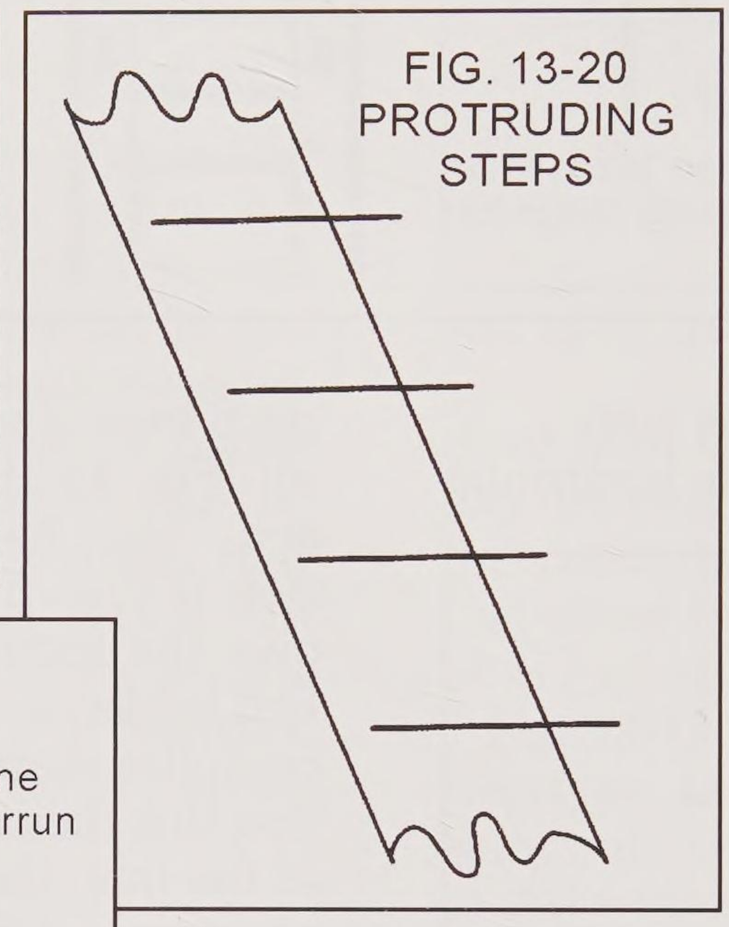


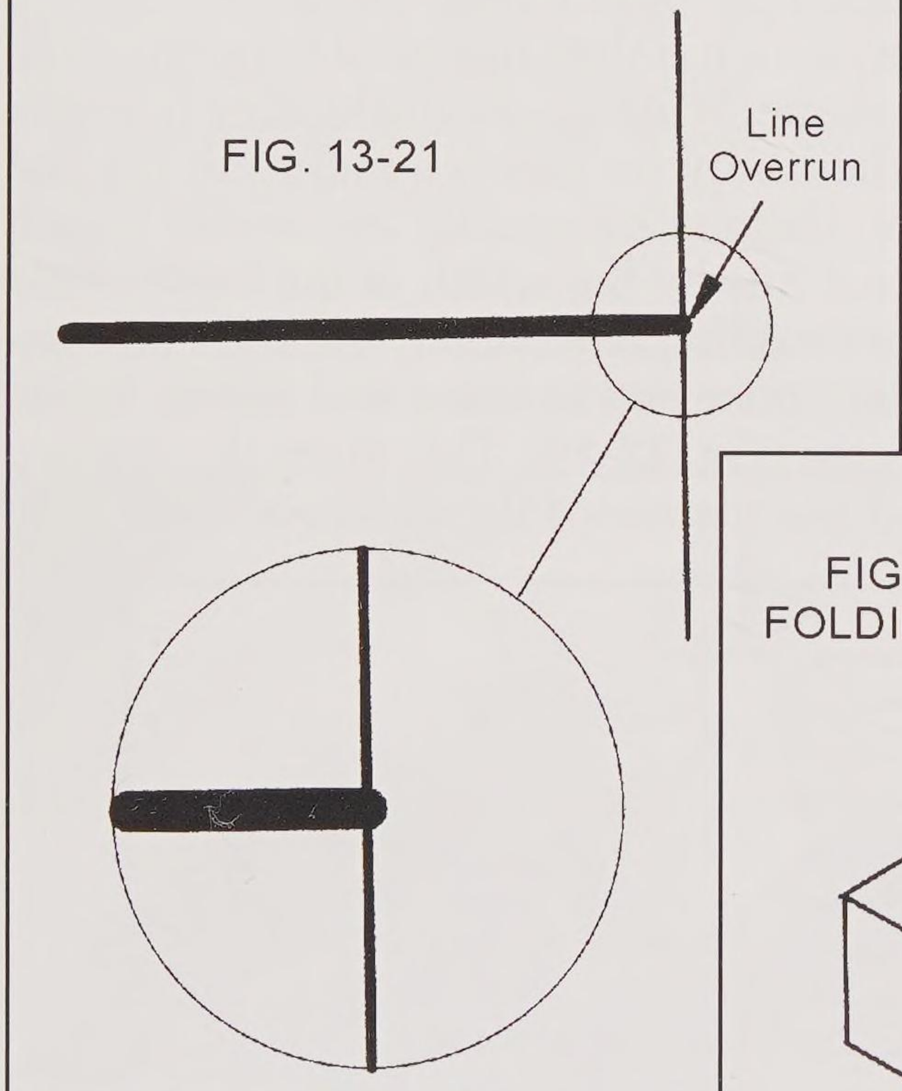
FIG. 13-17
HALF STEP
TEMPLATE

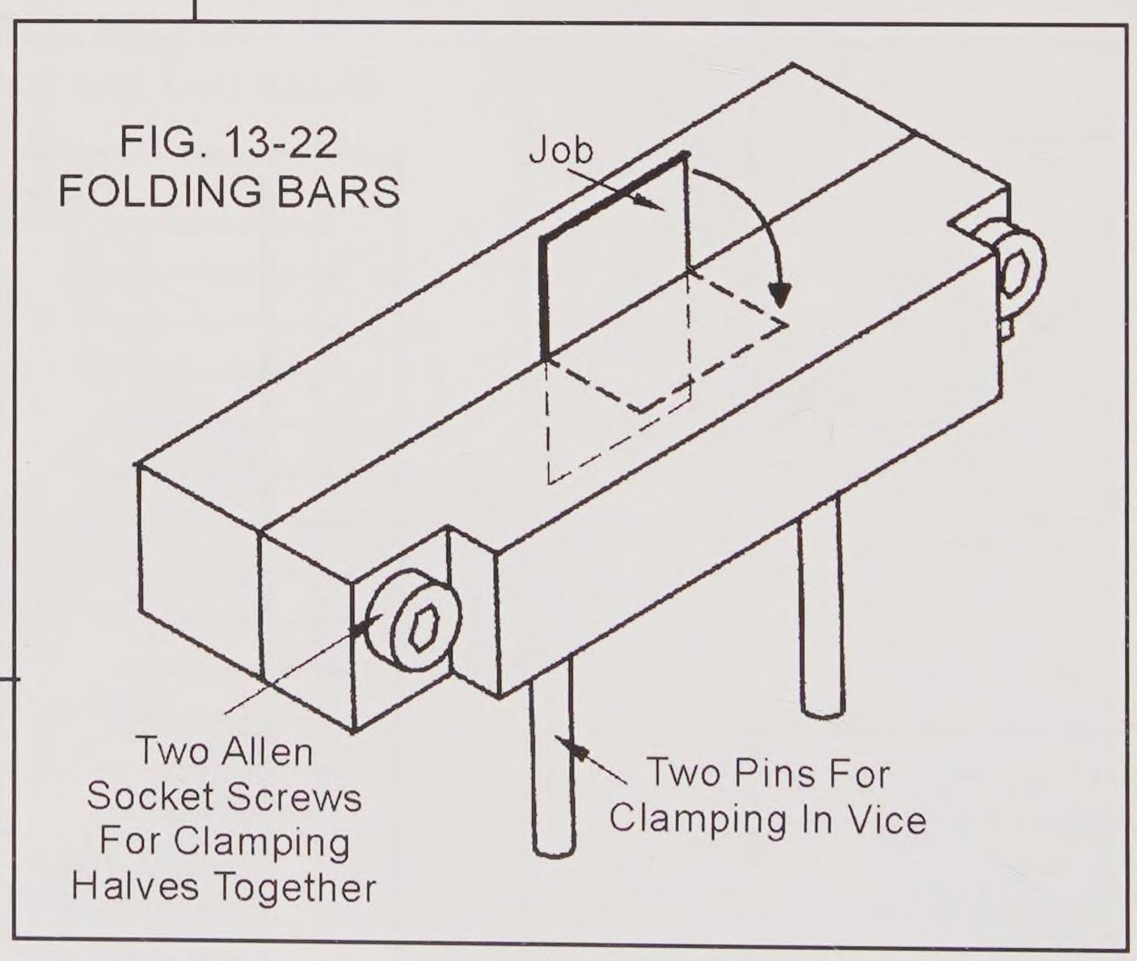
FIG. 13-16
LADDER
TEMPLATE











dimension. Note that you still need your locating points to position your step on the basic grid. This method produces step widths approximately pitch length. If the width of the stiles is less than the pitch, then the step width must be reduced; otherwise, when bent, it will protrude beyond the stiles (**Fig. 13-20**).

One further point is that by using the "filling in method," you have no overrun (**Fig. 13-21**) caused by the radius at the end of the line. This can be difficult to remove.

Assembling step ladders

After much trial and error, I have arrived at the correct way to fold etched, step-type ladders.

1) Cut the ladder from the matrix and clean up the stiles
2) Using the folding bars (**Fig. 13-22**), fold one stile *closely* on the step ends *toward* the step's chequer plate face (if so marked).
3) Fold the other stile as close to the steps as possible – you still have to bend the step up between the stiles. It pays to cut a piece of Perspex or hardwood to fit exactly between the stiles to aid in folding the second one.
4) Fold the steps between the stiles to the correct angle; i.e., stiles slope, but steps are level. Check that all steps are parallel and at the correct angle!

NOTE: I now put the "hinges" (where the step joins the stile) at the **front** instead of at the back like I previously did. This makes a neater job. Get the ladder the right way up with the chequer plate design on the top of the step – it is so easy to position the step upside down.

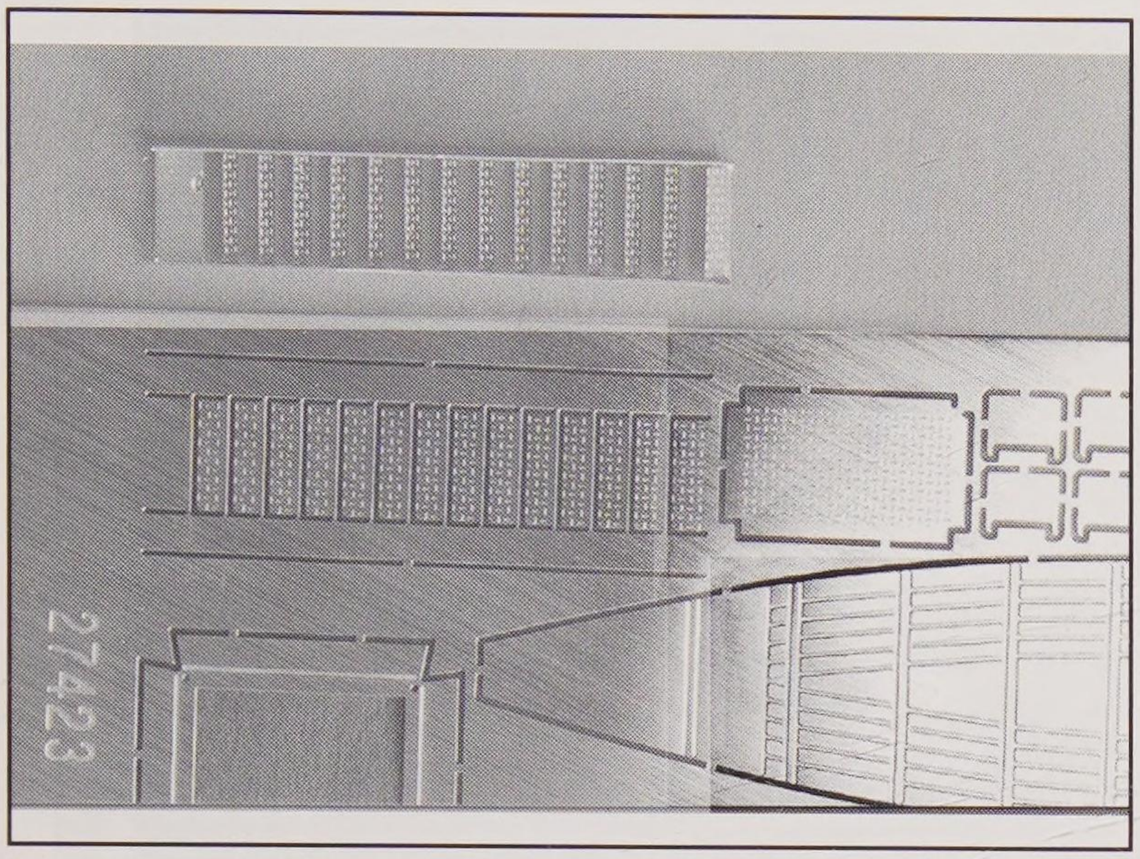


FIG. 13-23: Folded etched ladder with blank underneath,

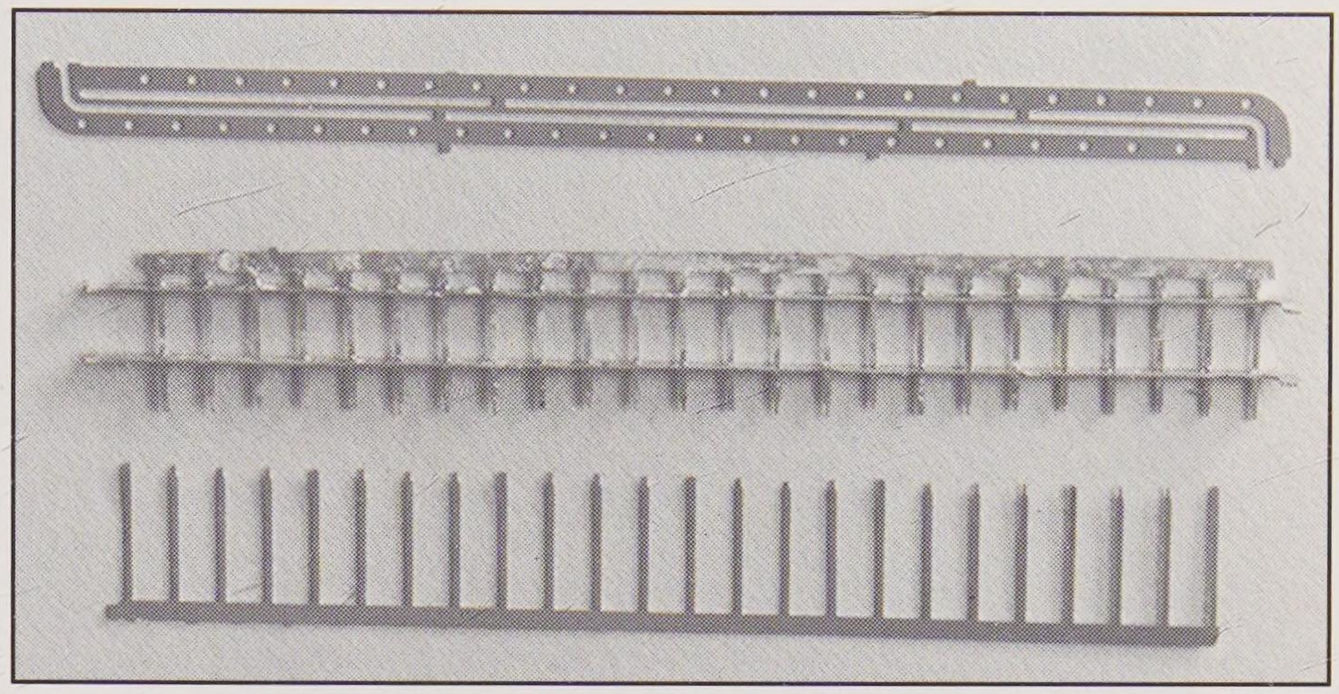


FIG. 13-24: Round rung ladder.

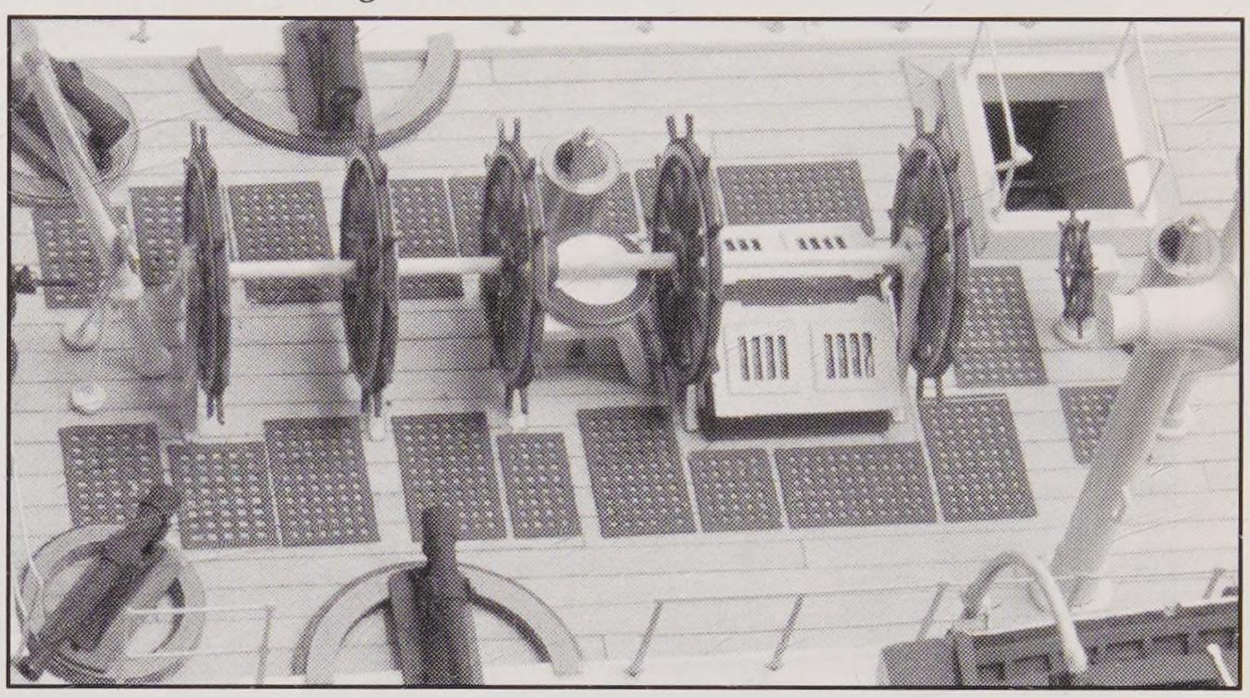


FIG. 13-25: Helmsman's gratings.

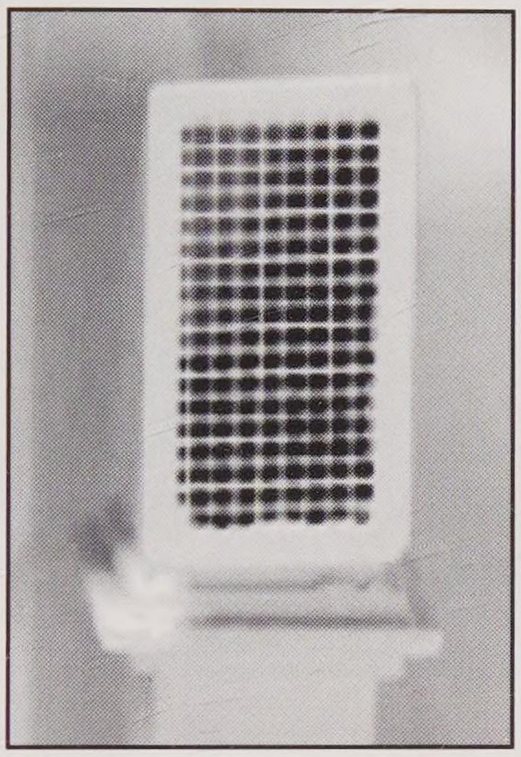


FIG. 13-26: Vent grid on *Duilio's* fore funnel.

Soldering: Do not use solder paint, as it makes too much mess to clean up afterward. Use cored solder and Baker's fluid, which is essential if the solder is to run and form the fillet under the step-stile junction. Turn the ladder upside down and hold it firmly. Apply Baker's fluid to the inner stile face (which includes the underside of the step ends). Run the hot soldering iron down the outside of the stile, pause at each step, and dab solder at each junction. Keep the application to a minimum – you are aiming to put a slight radius of solder connecting the stile and step. Check that this has happened at every step. Run the iron smoothly down the stile's outside face to clean it. This is necessary as the previous operation usually leaves the odd blob of solder.

Fig. 13-23 shows a folded step-type ladder with the etching sheet underneath.

Round rung ladders

Construction is different for these ladders (**Fig. 13-24**). They consist of two identical etched stiles (side members) with holes etched for the rungs. The latter can be bits of wire cut long and threaded through the holes. You need a simple fixture to hold the stiles in position whilst soldering the wires. Cleaning is the final operation.

However, inserting 12 or more separate pieces of wire can be frustrating, and cutting them almost always raises burrs that make threading difficult. An alternative method is to etch a rung "comb" (**Fig. 13-24**). The pitch must be the same as the hole pitch, but this stabilises the rungs and makes final assembly easy. The rungs are not round in section as they should be, but this does not show if the scale is small.

Grids

Etching is by far the easiest way to manufacture all kinds of grids. **Fig. 13-25** shows the "wooden" grids on which a helmsman stands, and **Fig. 13-26** shows a ventilator's protection grid on *Duilio's* fore funnel.

My first use of etching was the guardrails around *Victoria's* Admiral's walk (**Fig. 13-27** c/s). I still do not know a better way of making this delicate pattern, which is nearly always diamond shaped. Another example of where nothing else will suffice as well as etching is given in **Fig. 13-28** on the following page.

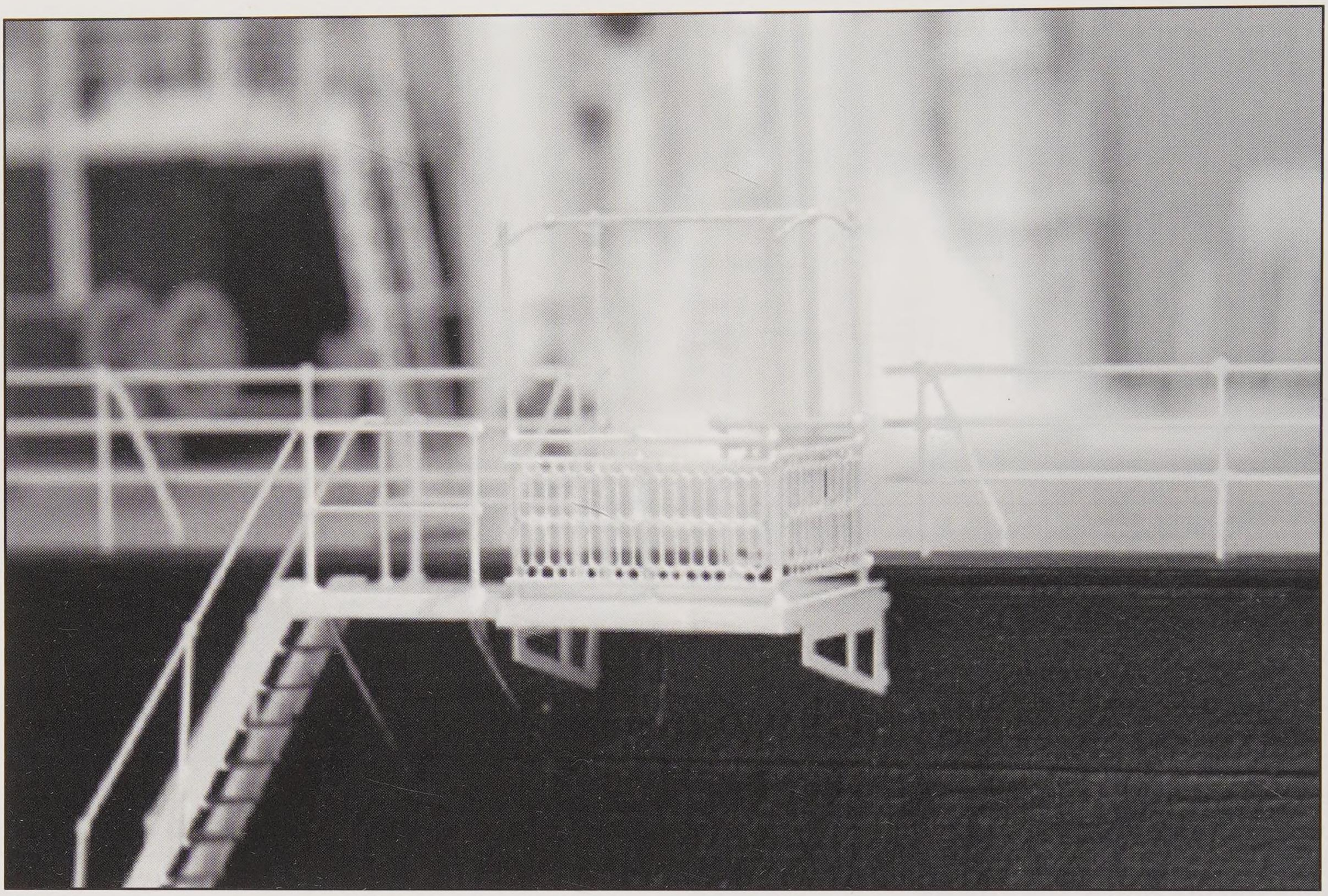
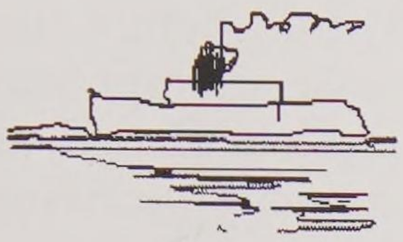


FIG. 13-28: Intricate cast ironwork at the head of *Duilio's* accommodation ladder

Chapter Fourteen



Painting

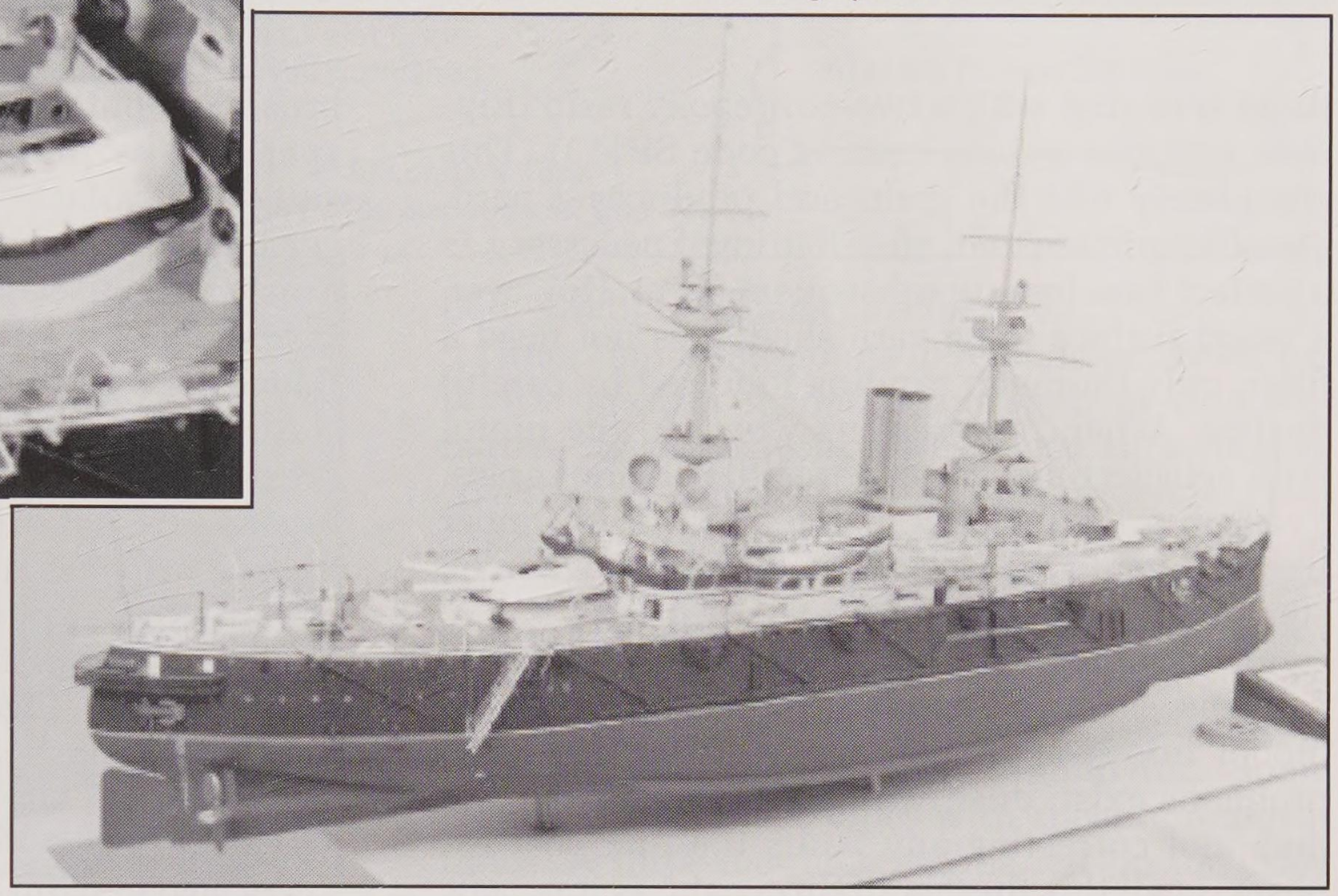


FIG. 14-1 (below): The thin white line on *Magnificent*.
FIG. 14-3 (inset): Blast plates on *Magnificent*.

A Victorian battleship's paint scheme was mainly black hull above the waterline with a white and buff superstructure. The waterline was always a very *narrow* white line (**Fig. 14-1**). Some models have a wide one, which is quite wrong and destroys the atmosphere. Occasionally another broader white stripe immediately under the deck was adopted. Sometimes the superstructure had a coloured stripe around it and/or the battle honours of the ship's name written across its front. (Ships often carry on a predecessor's name, so its history goes back a long way). **Fig. 14-2** (c/s) shows a narrow blue strip round the superstructure just above *Victoria's* gunports.

Wood decks are usually unpainted, although areas covered by iron or steel blast plates are. The plates, which prevent muzzle blast from burning the wood, are usually laid in arcs below the muzzles of the main armament. **Fig. 14-3** shows *Magnificent's* blast plates and **Fig. 14-4** (c/s) *Victoria's*. The two cowl ventilators immediately in front of *Victoria's* gun turret were removed before going into action. As the model is shown with the cowl ventilators in place, depicting the gun tampions in place also is correct.

From 1903 to the first World War when camouflage was used, the whole navy went uninterestingly and uniformly grey except for ships on special duty – a bad day for modellers!

Before 1903, captains had some say as to their ship's colour scheme. Naval intelligence within the author's family (a "chippy" serving on *HMS Magnificent* in 1894) said that colours were mixed on board with anything they could lay their hands on added to the can! If the captain had a large purse, which was not too often, the ship's boats and their crews were immaculately, and sometimes colourfully, turned out. Battleships, by their very nature, tend to be somewhat drab, and any excuse to add a bit of colour was taken; hence, Admiral's barges painted green.

Paint foundation

The basis for a professional paint job is thorough preparation, and this is particularly true when the part is wood. The best way to finish

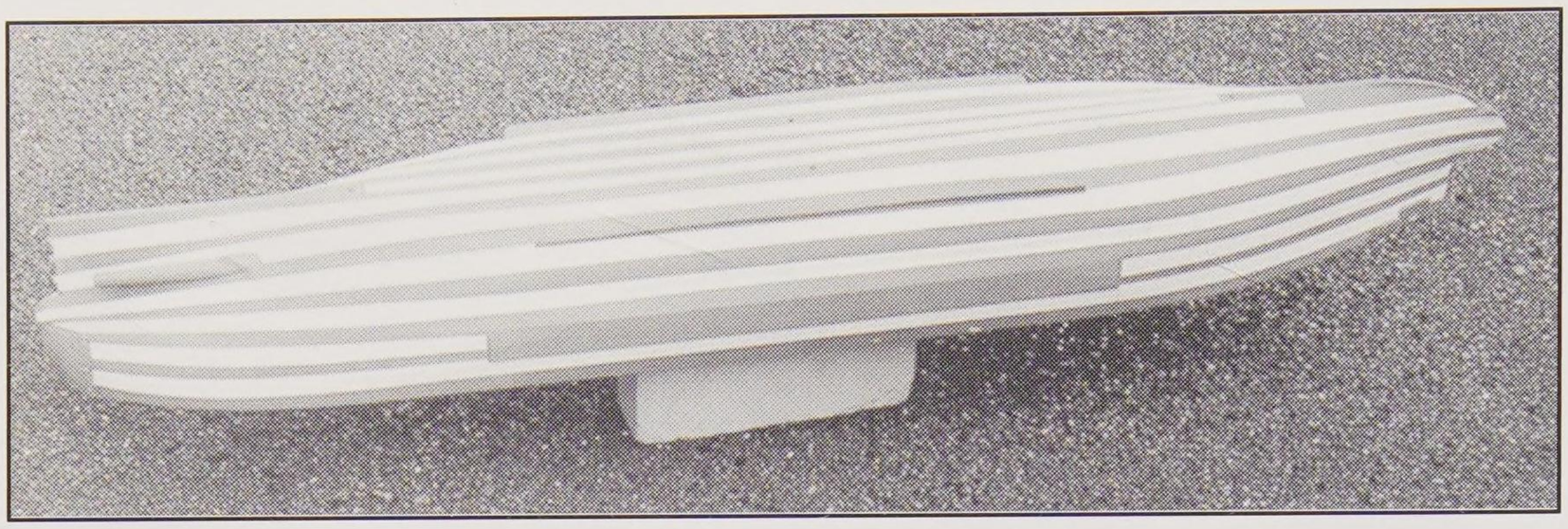


Fig. 14-5 (left) is a primed and "plated" hull before finish coating. No attempt was made to accurately plate it, as a plating expansion drawing was unavailable.

these is to coat with a two-part epoxy resin (Ripmax supplies a resin coating code SP113). This completely fills the grain and produces a hard, glasslike surface that, after flatting if necessary, is a perfect base for any subsequent paint. However, a wood surface to be varnished does not need a filler, only thorough sanding followed by careful dusting. When representing wood on the prototype, select a timber with very little obvious grain. Even on a large model, using a real ship timber like oak would turn a scale sailor's ankle when he stepped in a grain pit!

Advanced Ship Modelling thoroughly discusses painting, as the paint job can either elevate a good model into a superb one or ruin it. Two main problems exist: dust, which may be largely hidden, and correcting any faults the first coat exposes. I call this the "rectifying coat," as it reveals excess glue, rough patches, and even construction errors. Strong as the desire is to press on and finish the model, these faults must be put right before continuing. If necessary, repeat the rectifying coat and do not carry on until that little voice inside you – the taskmaster who evaluates your every move – says okay. This is the only path toward perfection. (We have all seen too many models where that wee voice was ignored.) However, you will never achieve total perfection, because that has been denied us. Only the gods attain it, but you might earn a gold medal!

Dust is always with us and can only be kept at bay by developing an anti-dust technique akin to surgeons in operating theatres. Assume the dust is there even if you cannot see it and take steps to eliminate it. Plastic surfaces develop electrostatic charges that attract dust like wasps to a honey pot. Spraying over dust merely seals it in, producing a pebbly finish. This causes more sanding and more dust. Never assume anything is dust free unless you have *just* cleaned it!

Brush or spray?

There is no contest in my mind – spray every time. Some modellers do a superb brush job, but experienced modellers can always spot it. The problem with brushes is that the subject's surface influences them. Holes and corners will, for example, bleed paint from the brush and cause a "sag." Since air- brushes are not in contact with the surface, it does not influence them.

Airbrushes are expensive, and you need a compressor if you are serious about this game. Airbrushes are not easy to use and must be kept extraordinarily clean to work properly, but make no mistake, they do a superb job. Take my advice and buy both items, then practice until their use is second nature. **Fig. 14-6** shows the author spraying *Duilio's* mast.

Paints

Try also to paint with acrylics and not enamels. Acrylics are easier to use and make gun cleaning simpler, as water is the medium and not white spirit. They have, however, a more restricted colour range and come mainly in either gloss or flat when what is really wanted most of the time is semi-gloss (egg shell). **Fig. 14-7** shows the mast

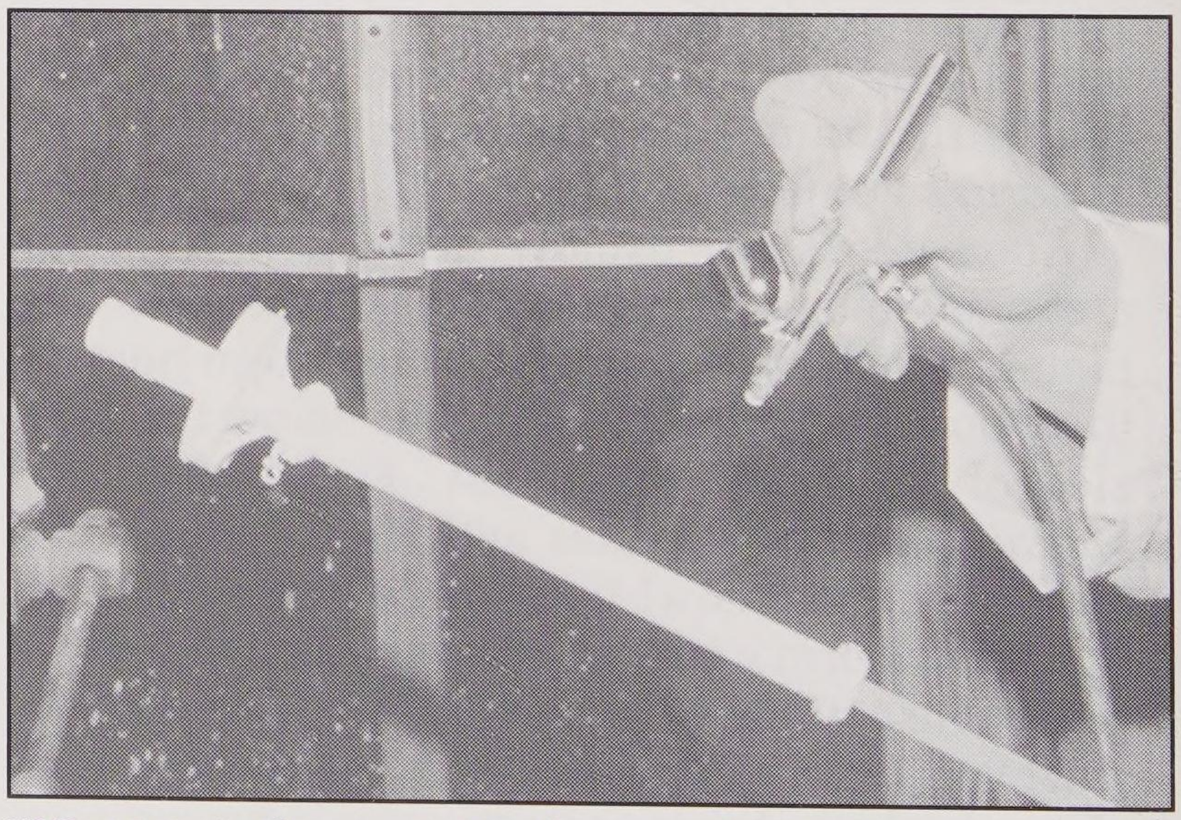


FIG. 14-6: Author spraying the mast for *Duilio*.

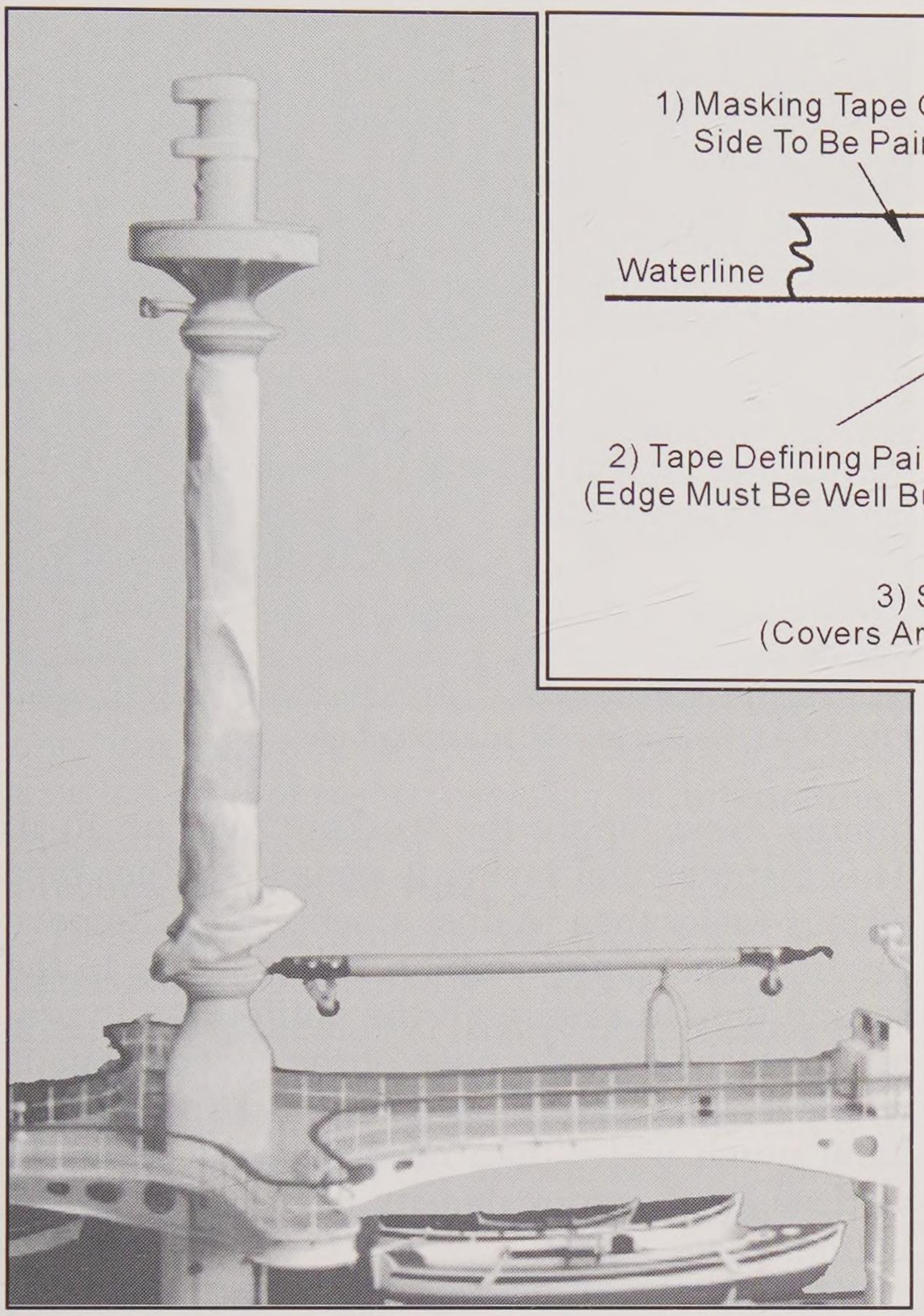


FIG. 14-7: Mast stepped and protected with tissue paper.

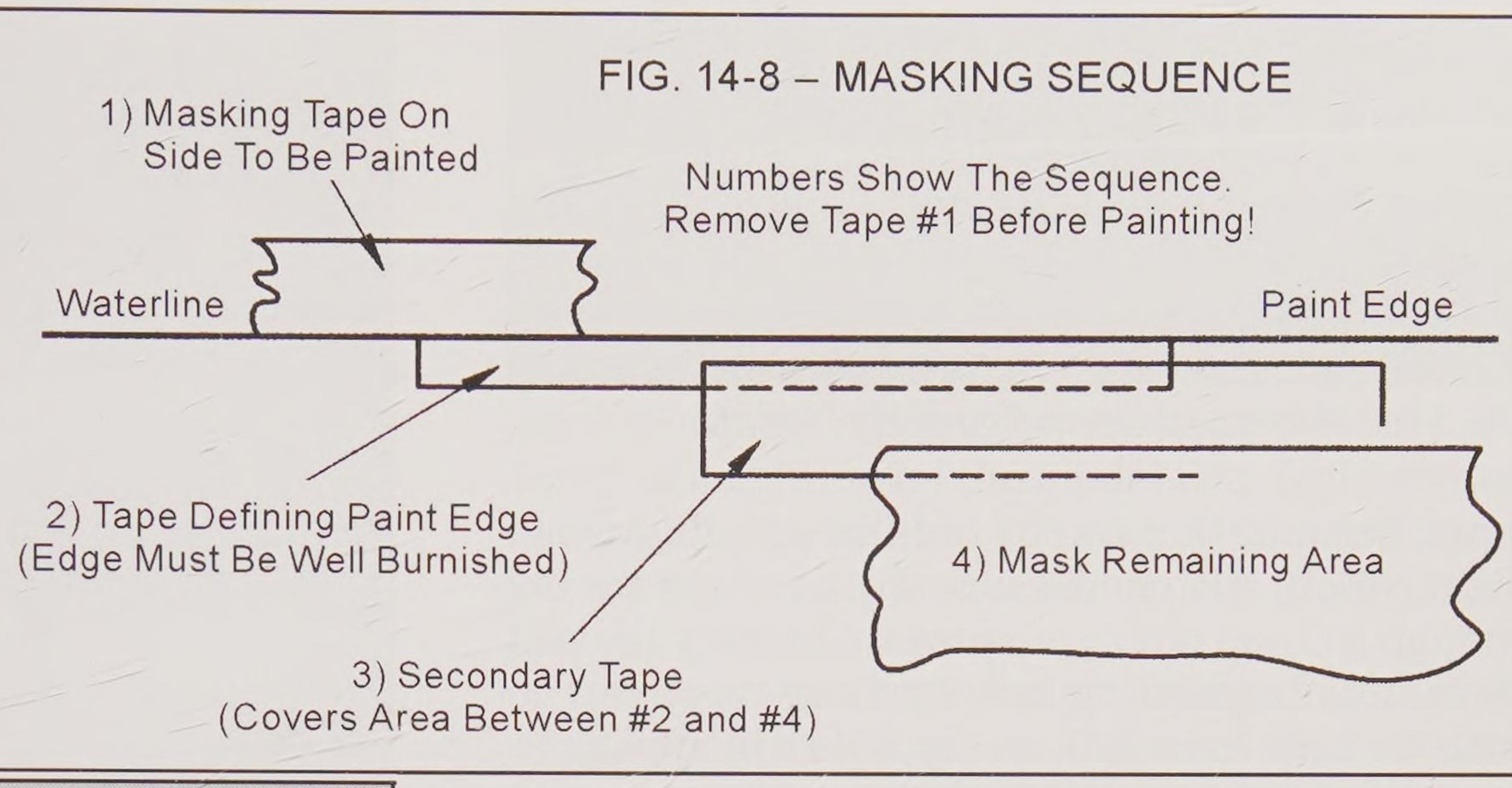


FIG. 14-8 – MASKING SEQUENCE
1) Masking Tape On
Side To Be Painted
Numbers Show The Sequence.
Remove Tape #1 Before Painting!
Waterline
Paint Edge
2) Tape Defining Paint Edge
(Edge Must Be Well Burnished)
4) Mask Remaining Area
3) Secondary Tape
(Covers Area Between #2 and #4)

from **Fig. 14-6** erected on the model. To avoid handling a matt surface likely to finger mark badly, it has been protected with tissue paper.

The alternative to an airbrush is to use acrylic car aerosols. They do not require a compressor or cleaning. Matching colours may cause occasional headaches, but the range is now quite wide. I find big cans spray better than little ones.

Masking

Always use tape specifically manufactured for masking. Ordinary tape has far too strong an adhesive and will strip off paint if given half a chance. The exception is where you have an unpainted surface such as a Perspex component and are masking it to produce, say, a window. In this case, Sellotape (transparent tape) will produce a clean line, but you may have to remove unwanted adhesive after lifting the tape. Once the paint has dried thoroughly, apply white spirit on a cotton bud (swab) to soften the adhesive.

Other important points to remember: Never expose a masked model to sunlight, as this will harden the adhesive. I always keep such models covered up. Never leave the tape on longer than necessary. You do not want it to start feeling at home and become reluctant to come off! Always pull tape back on itself so its edge cuts the paint film. Pulling it off at right angles to the surface will end in tears, because you are likely to get paint rip off, which is highly annoying. Some manufacturers make tapes with specific removal times. A three-day tape can be left on for three days, etc.

It is most important to plan your paint job carefully. Work out which procedure produces the easiest masking job. **Fig. 14-8** shows a typical progressive masking technique. Try to avoid taping over protruding pieces near the paint edge. This is likely to cause leaks, as the tape will not lie down. If leaks occur, tackle them *immediately* as you peel back the tape. Have water (acrylic paints) or white spirit (enamels), cotton buds, and brushes at the ready. The point is that leaks, because the tape has covered them, may still be soft enough to be removed. Leave them overnight and your efforts will be for nought!

Leaks can be avoided if the "working" tape edge is burnished down tight. Rub this with a piece of end grain balsa. Spray a light, "dry" application across the edge and not into it, then allow to dry. This seals the edge. Do not overload the tape edge with a juicy, wet spray and expect to get away with it. Remember, only the working edge must be paint tight; do not rub down hard on any other

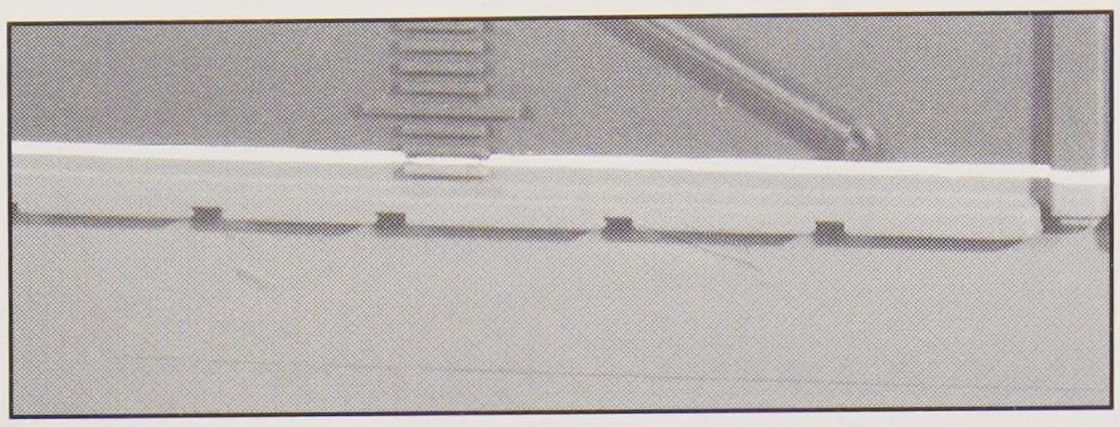


FIG. 14-9: Shoring strake on *Empress of India*.

areas, because that can be putting up a hostage to paint rip off. Also make sure any overlaps are big enough to keep out over-spray or, better still, seal them. It is frightening how far over-spray can go with no help from you, as my wife can attest!

A masking example

My method, tried over many models, is to first spray the antifouling onto the underwater hull (and not forgetting the rudder if unshipped). This is usually done with the hull upside down. Once back on its building board, mark out the lower edge of the waterline using the building board as a datum. Drawing the waterline can be a real trial. You may not be absolutely certain where it should be. Waterlines vary in height throughout a ship's life. Vessels become heavier with age, mainly through alterations – carrying more weapons, fuel, or equipment.

HMS Devastation had a peculiar notched strake along its hull at about waterline height. Its purpose baffled me for some time until I saw a picture of the vessel in dry dock. It was a shoring strake! Early shots of the ship show this strake above water. At the end of *Devastation's* life, the strake was underwater. **Fig. 14-9** shows *Empress of India's* shoring strake near the top of the antifouling.

Before attempting to put any lines on the hull, make sure it is accurately aligned with respect to the building board. Check heights fore and aft and at both sides of the waist to ensure the model is truly upright. Also make sure the building board is flat. I use a Vernier height gauge equipped with a pencil instead of a beak to draw on the waterline. **Fig. 14-10** shows the waterline being marked on *Duilio's* torpedo boat. However, anything will do as long as it can hold a pencil stable and at the wanted height.

Now put a strip of masking tape *above* the waterline and get a fair run with no lumps or

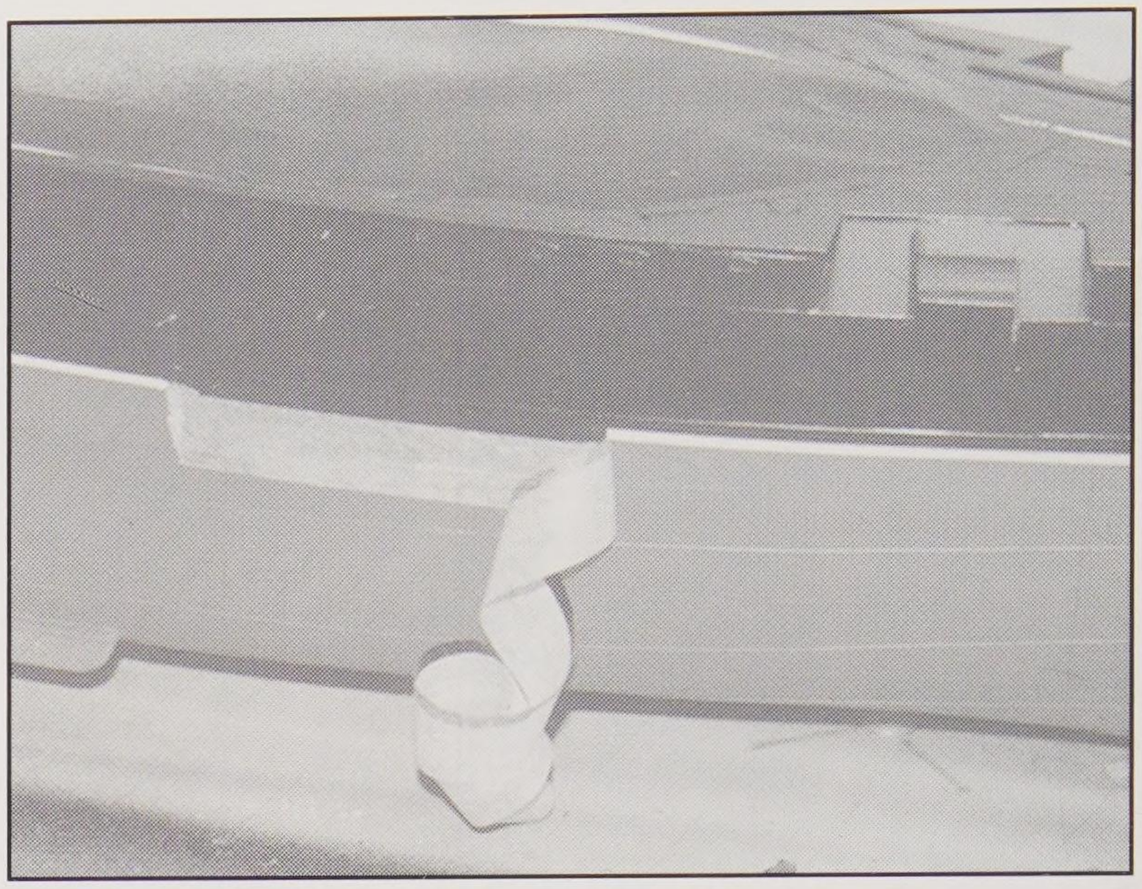


FIG. 14-11: Removing the masking tape.

bumps. Next, apply the working tape up to it. This assumes that laying it against another tape edge is easier than against a pencil line. Remove the first tape. Apply any backup masking to the second tape to ensure all the antifouling is protected. Make sure the edge of the second tape is well rubbed down. Then spray a strip of white paint much wider than needed, making sure to achieve good colour density particularly at the bottom edge.

Mark the waterline's top edge as described and repeat the masking process. With the waterline protected – it may be only $^1/_{16}$" wide – spray the black hull colour. This method produces a proper painted waterline of constant width. Some people cheat by applying a strip of white tape, but you have shown mastery of masking and painting – you are a craftsman! **Fig. 14-11** shows removing

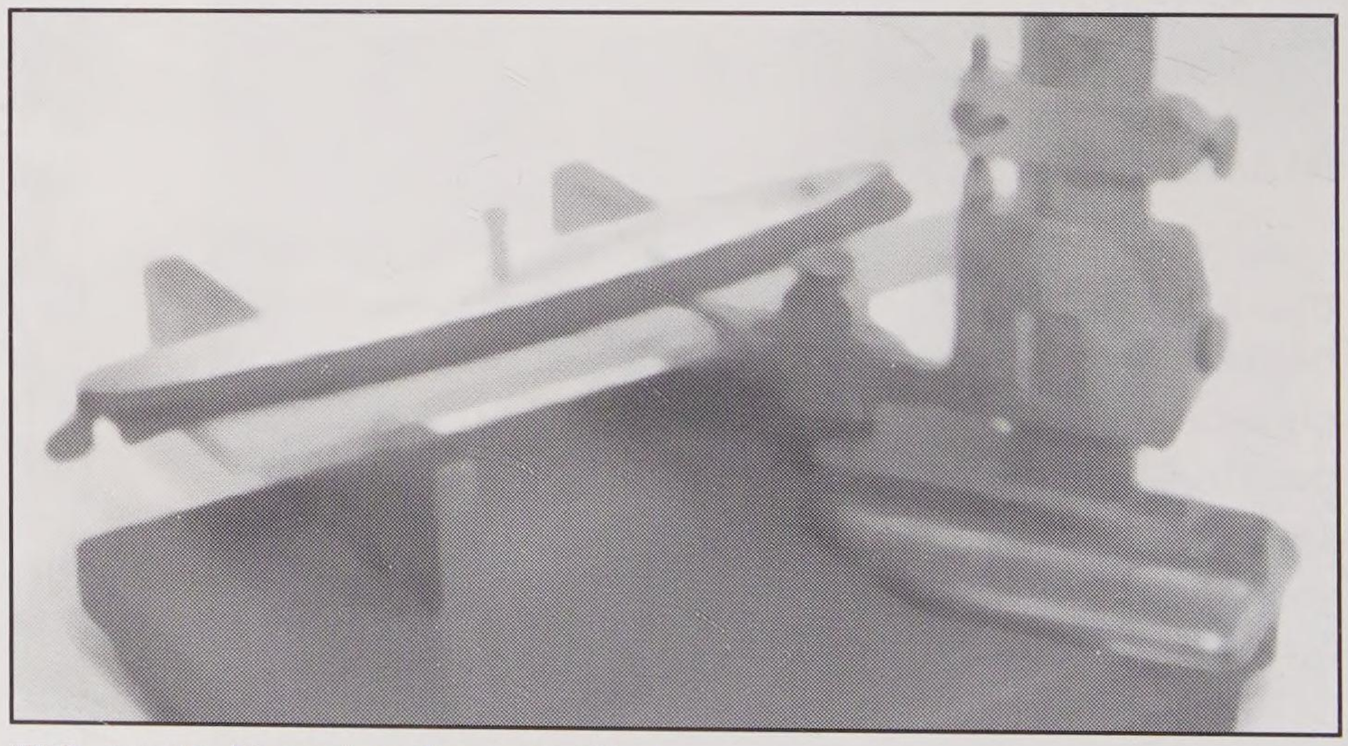


FIG. 14-10: Drawing the waterline.

the masking tape defining the top edge of the white boot topping (waterline).

One further point is even if the waterline is shown perfectly horizontal, it is a good idea to lift the first and last 6" to 8" inches slightly. This prevents the optical illusion that the hull is hogged.

Holding minute components whilst painting can be a problem. **Fig. 14-12** (c/s) shows a cotton bud stabilising a small ship's boat whilst the top of its gunwale is painted with the *side* of a brush.

Highlighting

The author is not keen on aging or distressing a model. This practice seems to have come to a natural end, but 15 to 20 years ago applying "rust" and "dirt" was done to excess. "Experts" even told us what kind of rust to use! Naviga (international modeling association) will not countenance the practice and neither will I.

However, one process will improve a model's appearance, particularly Victorian ships with their matt black hulls. That is highlighting. Matt black tends to hide details. Victorian ships had masses of detail on their hulls that do not show up at all in some light. The answer lies in highlighting an object's edges, but it has to be done subtly so no one notices. The secret is to highlight without it shouting.

Highlighting involves using paint lighter than the original coat. For instance, select a mid grey on black and a light grey on dark grey. Dilute the paint and use it as "dry" as possible. Run the *side* of your "dry" brush along edges and touch things such as hinges. Select the position of your "pretend" sun shining on the model and decide where the highlights will be. You can use the technique on grey as well. For instance, try a white line along a grey gun barrel.

You know you have it right when a highlighted area appears to look no different from before. However, when you look at an untreated area, it now appears dull and lifeless in comparison. This is what to strive for.

The secret is keeping your "dry" application to an absolute minimum. Be sure you can immediately remove any excess highlighting – again, water for acrylics and white spirit for enamels. Showing this technique in a photo is difficult, but **Fig. 14-13** attempts to capture *Magnificent's* highlighting.

Removing paint from a matt black surface can be difficult owing to its inherent roughness, so get

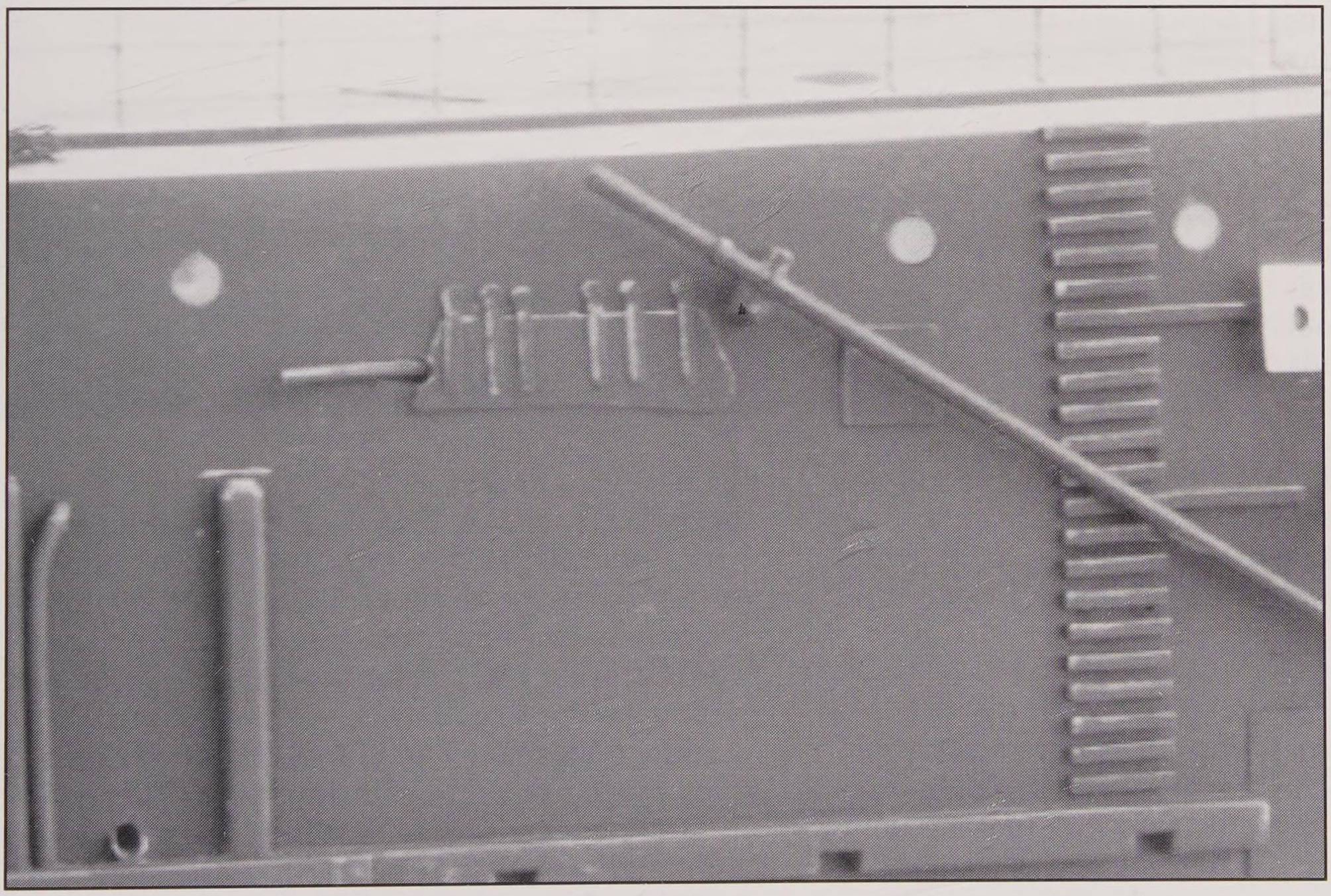


FIG. 14-13: Highlighting on *Magnificent*.

your technique right the first time. Always err on the "not enough" side – you can add more afterward. In any case, more may be needed after the paint dries. Experiment! Immediately remove over-enthusiastic applications, particularly if working with acrylics, as they dry very fast. Using oil-based Humbrol paints for highlighting is probably better, as they dry slower and are therefore easier to control. With acrylics, your little paint reservoir is continually skinning over.

Canvas dodgers

They always present a problem. At these scales, substituting cloth for canvas looks clumsy, so thin brass shim was fixed to the guardrails instead. If left as a painted surface, the canvas dodger's natural drapes and folds are absent. At the time this problem surfaced, there was a great but short-lived interest in painting military figures. Much was published about painting highlights and shadows on military clothing. It seemed logical that the dodgers' drapes and folds could be painted, too. This proved quite successful. I always painted the dodger as if a wind were blowing the canvas back onto the guardrail (**Fig. 14-14** c/s).

Using an airbrush

No shortcut to painting exists. It requires probably more care than any other construction exercise if it is to do justice to the work that has gone before. In particular, it requires much thought on the best way to mask. One could say that a paint job is really a masking exercise. It often takes hours to mask up, but only seconds to spray on the paint. **Fig. 14-15** shows *Victoria* and **Fig. 14-16** *Empress of India* (note the green Admiral's barge). The Victorian Navy colours of black, white, and buff make these models very eye-catching.

Only practice, or watching an expert, will teach you how to use your airbrush properly. One tip is to move your airbrush before it starts spraying and to stop spraying before the airbrush stops

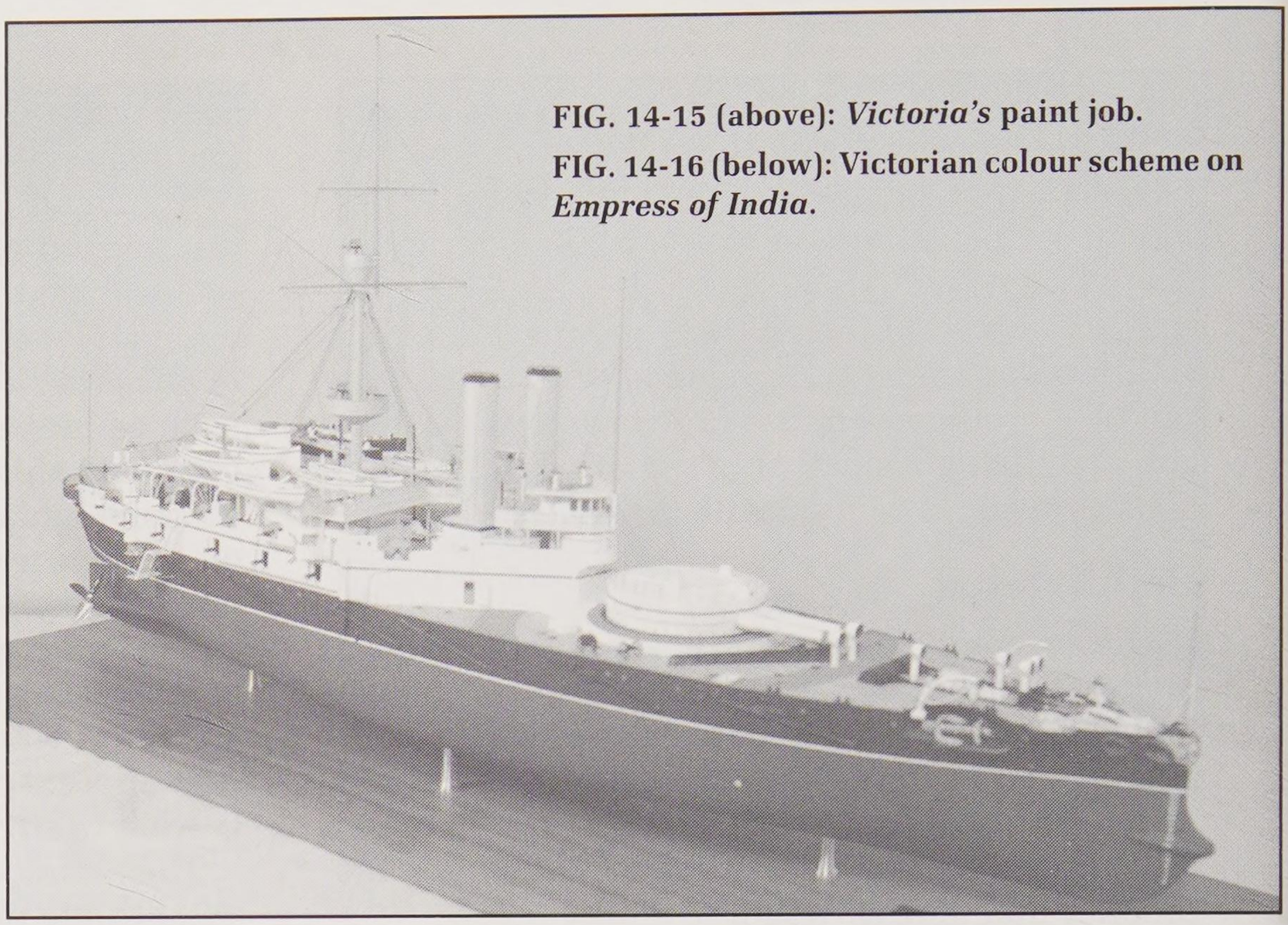


FIG. 14-15 (above): *Victoria's* paint job.

FIG. 14-16 (below): Victorian colour scheme on *Empress of India*.

moving; otherwise, you will have a blob at the beginning and end of the line. Keep a constant distance between object and gun, and do not angle it to the left and right. All the above ensures that the "cover" of the spray remains constant and you unwittingly do not apply more paint in some areas than others.

With practice, it is possible to "spot" paint a small area by firing a staccato burst of accurately aimed colour. This is not easy to do since, at first, your aim will be bad and your burst too long. You really need John Wayne's shooting skills, but they will come with practice and perseverance.

Finally, remember that airbrushes must be kept immaculately clean. Do not expect them to work if they are dirty. When selecting an airbrush, examine it with an eye to keeping it clean. The writer prefers an integral reservoir, as it eliminates the need to keep the joint between gun and reservoir clean. **Fig. 14-17** shows an Iwata airbrush with an integral, gravity feed reservoir. The most important components to watch are the needle, which must not be bent in any way particularly at the tip, and the spraying tip, which must not be damaged, split, or blocked with paint. Damage to either will produce a poor spray pattern, if you get one at all.

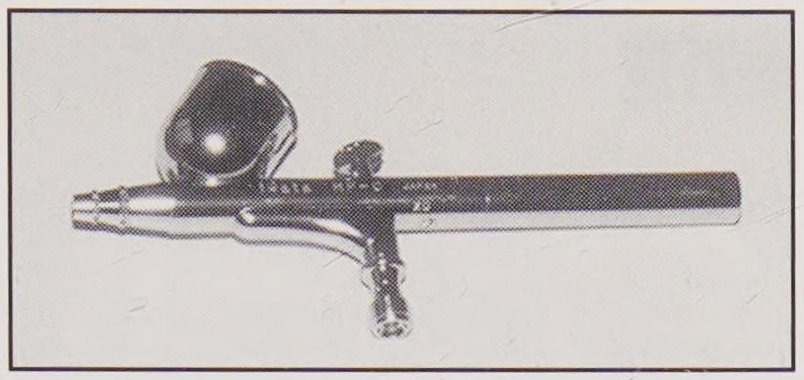
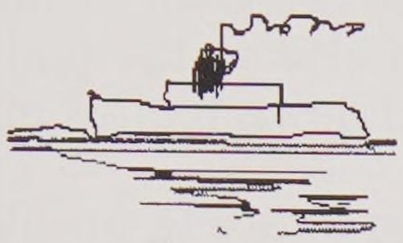


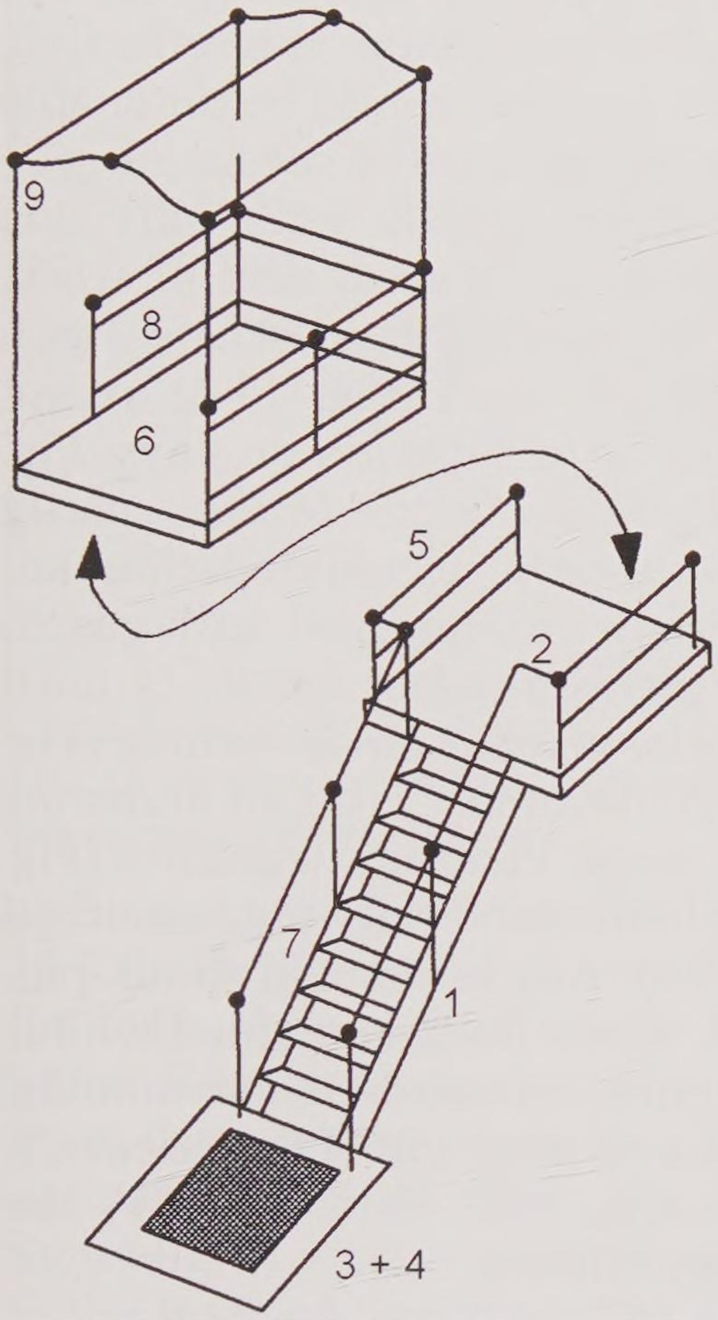
FIG. 14-17: Iwata airbrush with integral reservoir.



Chapter Fifteen

Alterations & Additions

FIG. 15-2 – *DUILIO'S* ACCOMMODATION LADDER



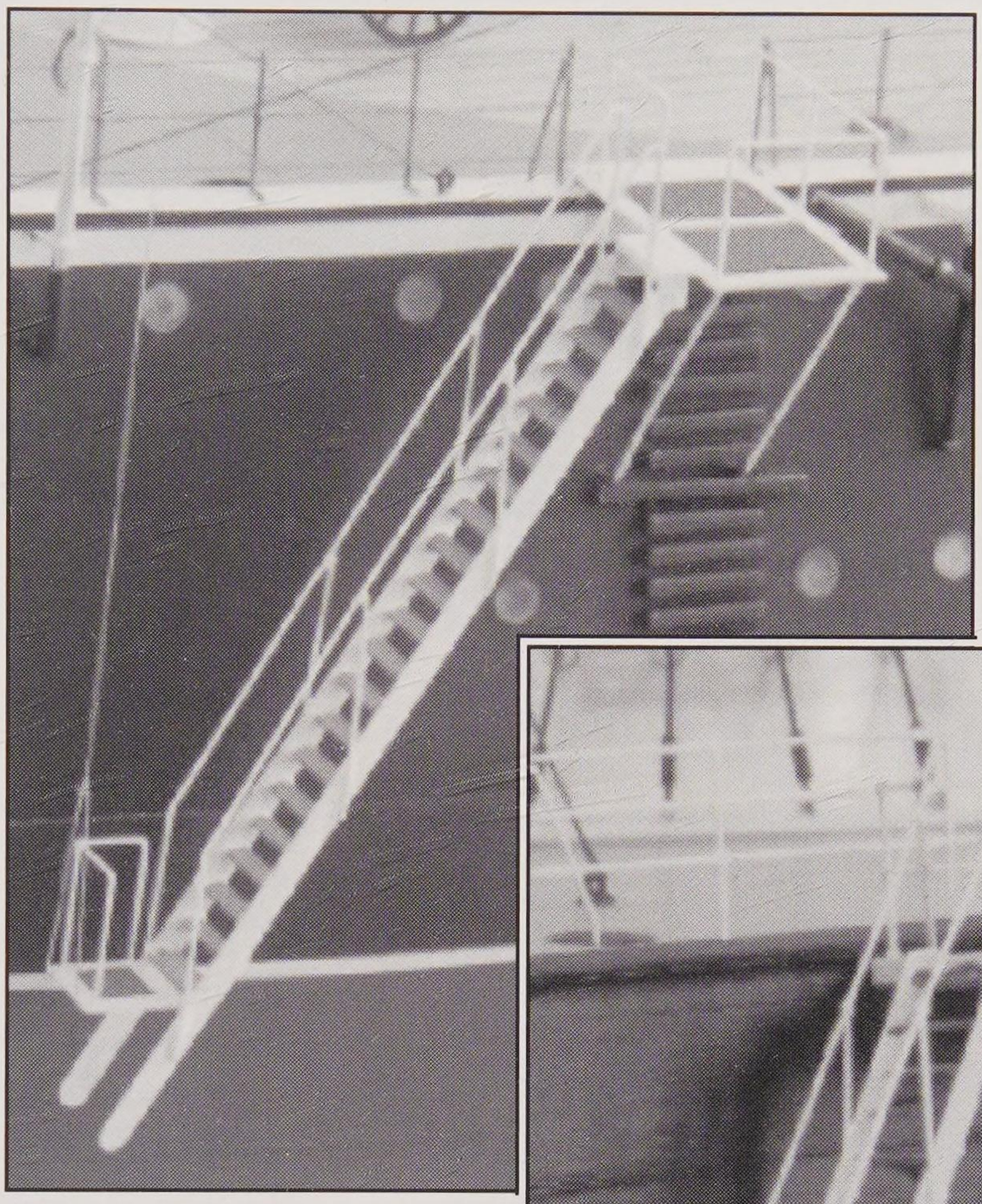
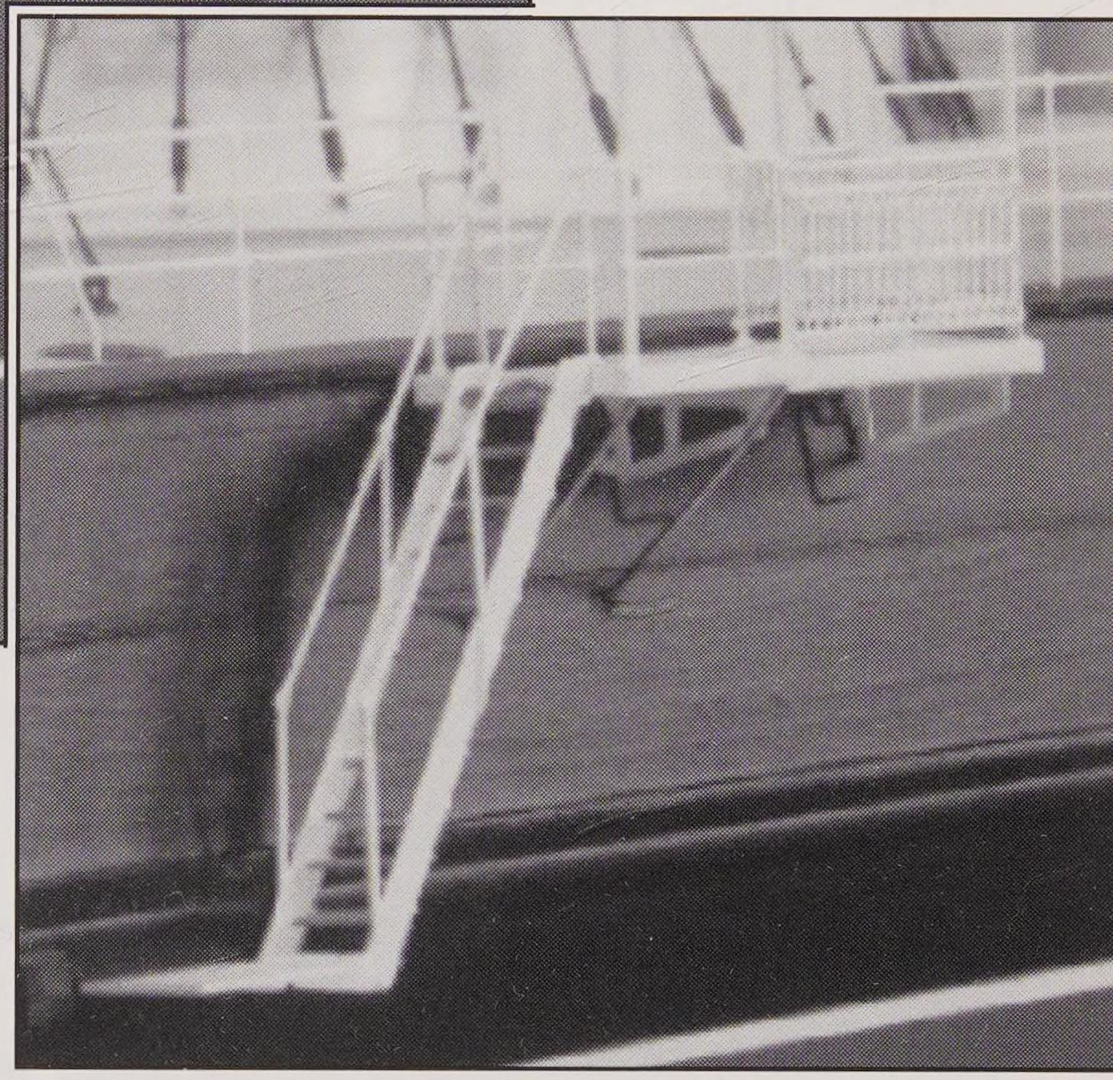


FIG. 15-3 (left): *Magnificent's* accommodation ladder integrated into the deck guardrails.

FIG. 15-4 (below): *Duilio's* accommodation ladder in situ.



I have used "Alterations and Additions" to cover items with no other home. (Alterations and additions are called A & A's in the navy.)

Accommodation ladders

These can be outstanding visual features and must be made and finished with care. Some ships have up to three ladders rigged along their length, and none may be identical. The most elaborate usually have a platform in the middle with a ladder above and below it. **Fig. 15-1** (c/s) shows *Victoria's* accommodation ladder. When the ship is underway, ladders are usually triced up to deck level where, in photos taken from about sea level, they practically disappear from view. In fact, their presence is often seen as only a shadow on the ship's side.

Drawing ladders to scale and sorting everything out is the best way to start (**Fig. 15-2**). For instance, how will the two or three platforms be fitted to the hull and to each other? Sloping struts usually take the load back into the hull, and the lower strut frequently has at least one horizontal stay stabilizing its position.

The ladder's guardrails also need careful attention. How will they be fitted and integrated with the deck guardrails (**Fig. 15-3**)? Platforms usually have a grid centre and ornamental guardrails are often wood capped. These features can be compli-

cated. **Fig. 15-4** shows *Duilio's* completed and fitted accommodation ladder with its ornate guardrails around the top platform.

At least one davit always supports the lower end, and a second is often near the top for hoisting purposes. The stile's lower end has a protective wood rubbing strake on the seaward side. If the scale is large enough to warrant it, do not forget the gangway boat rope. Lightly secured to and hanging from the upper platform, it leads well forward to lie nearly in the boat's fore and aft line. This rope is a great help to boats coming alongside in a tideway or rough sea.

The check line is a short length of cordage spliced to an outboard stanchion on the lower platform. Boat crews use it for checking their way and keeping the stern of the boat in the correct position relative to the platform. The check line is cheesed down (coiled on the platform) when not needed.

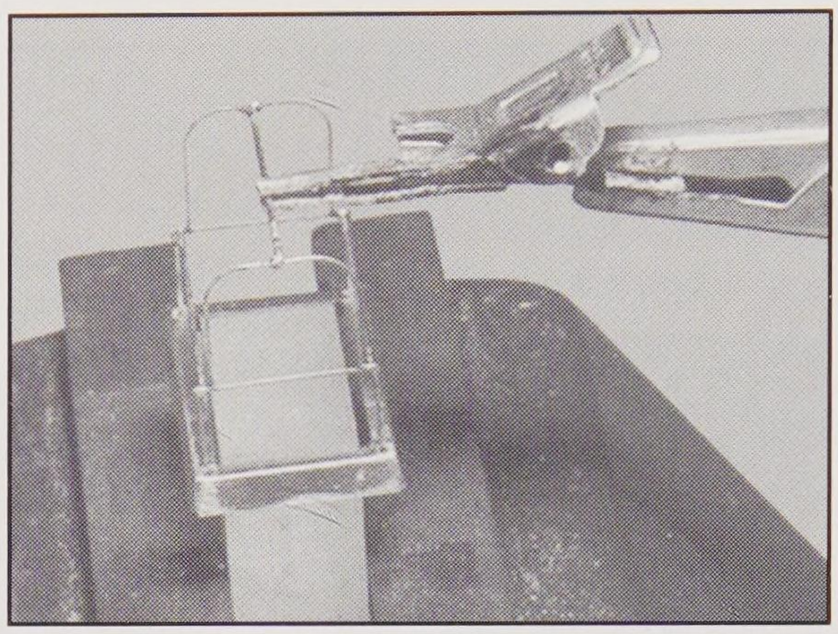


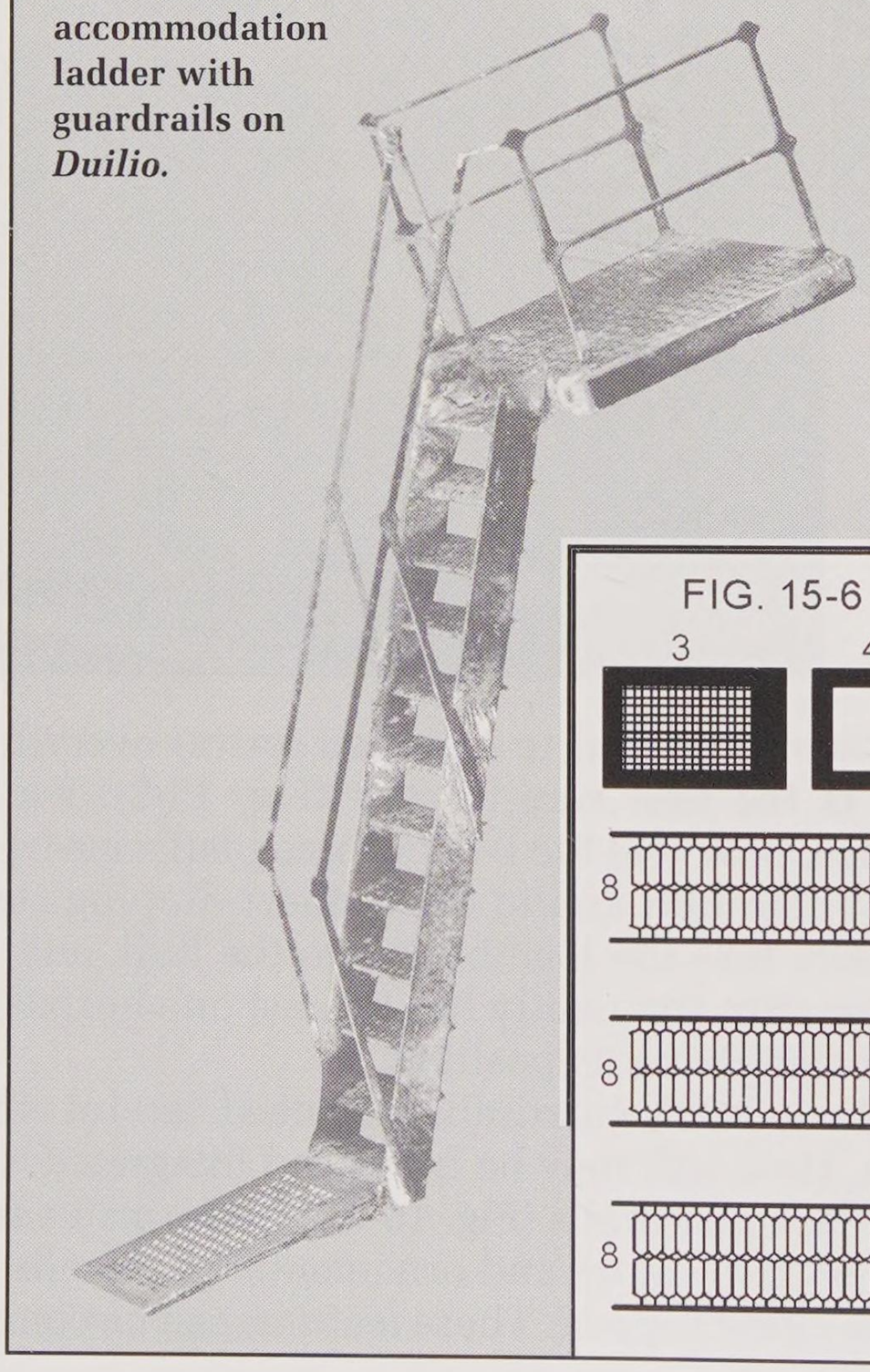
FIG. 15-9: Helping Hands supports awning during soldering.

Fig. 15-5 (c/s) shows *Victoria's* accommodation ladder. Note the davit supporting the lower end and the davit for hoisting at the top. The searchlight is too close to the water to be effective. Its position would be untenable with any kind of sea running.

Even ladders with only one flight are a great deal of work, but repay the greatest care. I etch all the parts (**Fig. 15-6**) except the wire supports or stays. **Fig. 15-7**(c/s) shows *Duilio's* partly built basic accommodation ladder and **Fig. 15-8** shows it equipped with guardrails. The upper platform (deck level) is most elaborate with provision for a canvas awning (**Fig. 15-9**). The sides are decorated with an elaborate design as seen on some Victorian windows (**Fig. 15-10**). All of this looks good only if geometrical accuracy is preserved. Any errors will shout, particularly when the whole thing is painted white.

An excellent picture of a standard accommodation ladder is shown on page 142 of the *Admiralty Manual of Seamanship*, 1967, Vol.2 (HMSO – Her Majesty's Stationery Office).

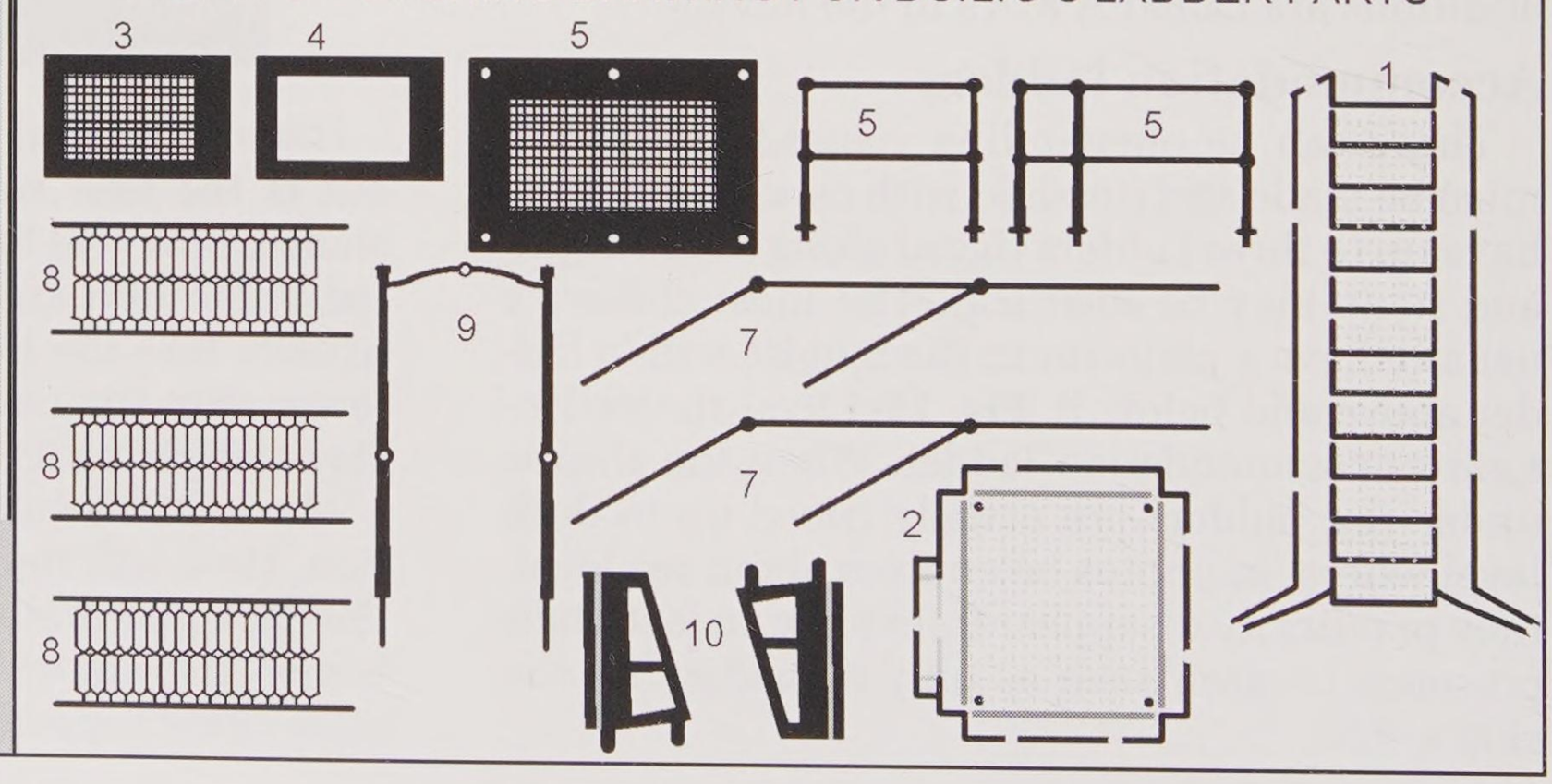
FIG. 15-8: Basic accommodation ladder with guardrails on *Duilio*.



Duilio's searchlight

The pedestal base could have been made from an

FIG. 15-6 – ETCHING DRAWING FOR *DUILIO'S* LADDER PARTS



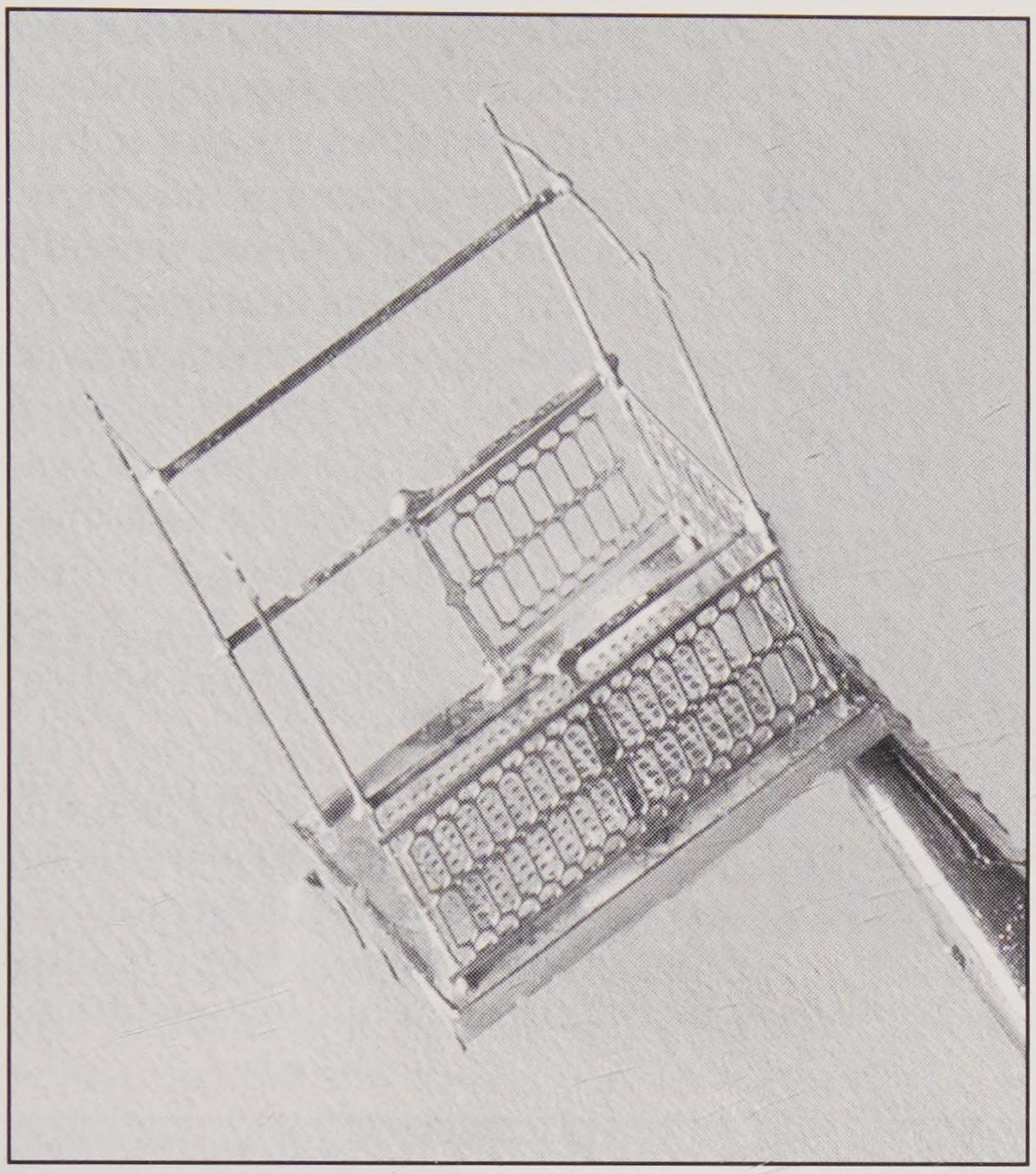


FIG. 15-10: Completed but unpainted top platform for *Duilio's* accommodation ladder.

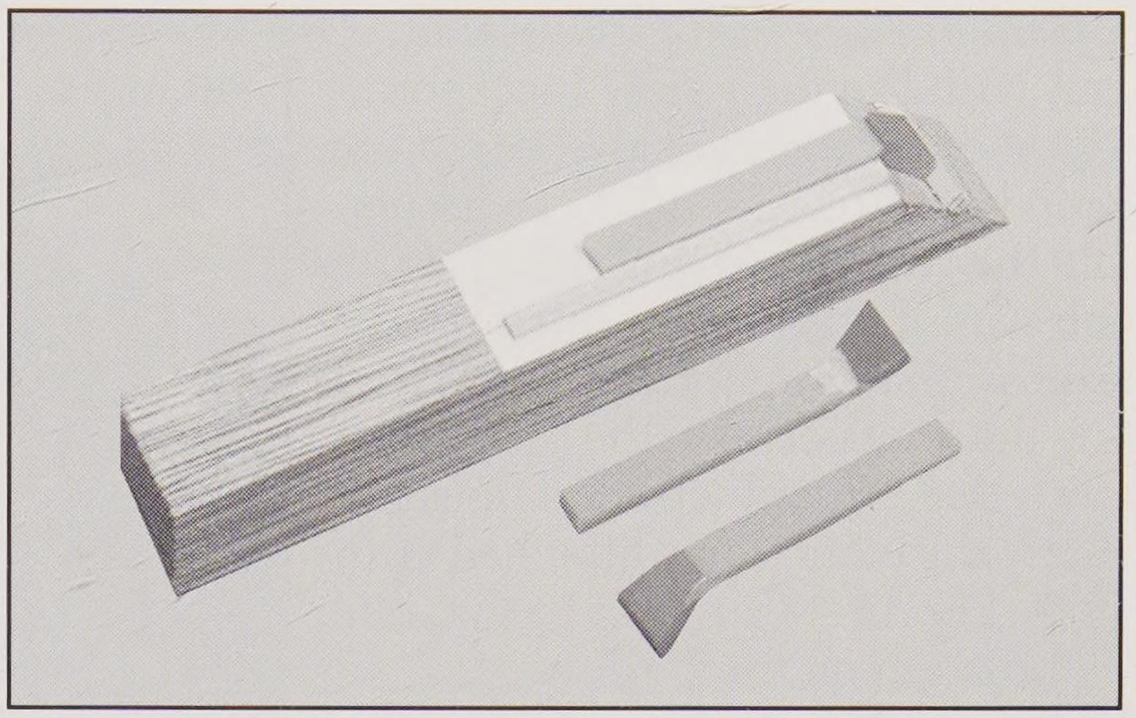


FIG. 15-17: Fixture for assembling the two gash chute parts.

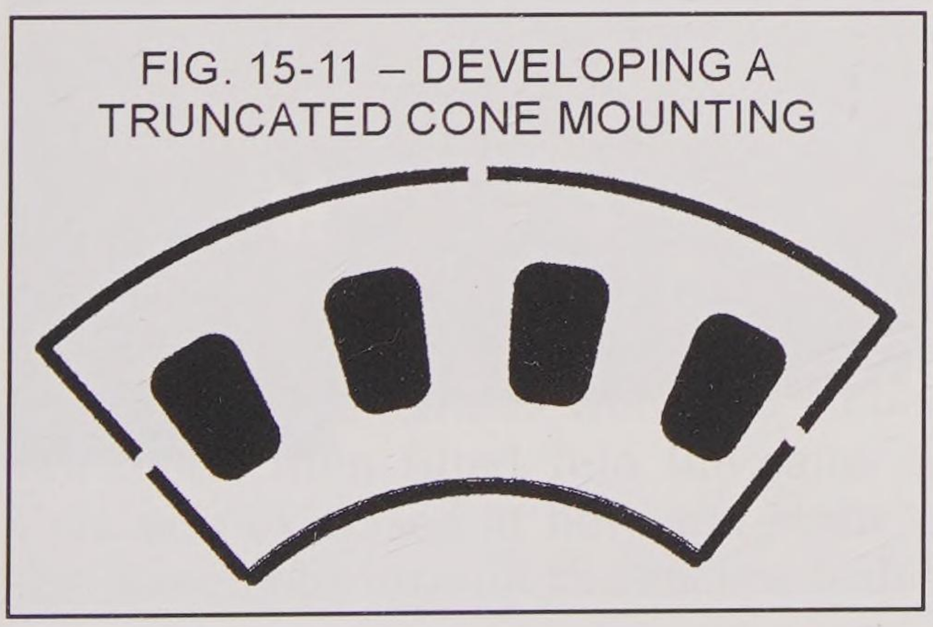
etching, but a brass turning was preferred (**Fig. 15-11**). The difficult part was the yolk supporting the light. This was made from 4 diam copper rod, rather than brass, so the arms could be bent. An 8mm deep cut was made into the end of the copper rod (**Fig.15-12**). This was opened with a flat Swiss file to 1.5mm wide. After thinning the sides to the finished thickness (**Fig. 15-13**), the material was annealed and the arms bent (**Fig. 15-14**). Then the curve to fit the light housing was formed (**Fig. 15-15**).

Next, the side elevation was filed to shape, tops rounded, and a transverse pivot hole drilled. The light housing was turned from Perspex, a straightforward job, but the transverse hole was drilled before parting off so the job could be handled. Drilling through a small, parted-off component is difficult. To avoid boring a 0.5diam by 6mm deep pivot hole through Perspex, which is likely to break the drill bit when it jams in the hole, drill the hole larger to reduce the length/diameter ratio, then bush it. Holes deeper than 2 diam are rare in most types of engineering, but not in model making!

The control wheel was an etching I found in the scrap box. It was glued to a separate spindle fitted into a hole in the housing just behind the main pivot. The lens frame was a custom etching. **Fig. 15-16** shows the completed searchlight on *Duilio*.

Duilio's gash chutes

These were made from two lengths of Perspex. A piece of 3mm Perspex was prepared with the top and bottom angles filed to form the main body. Parallel strips were then sawn off.



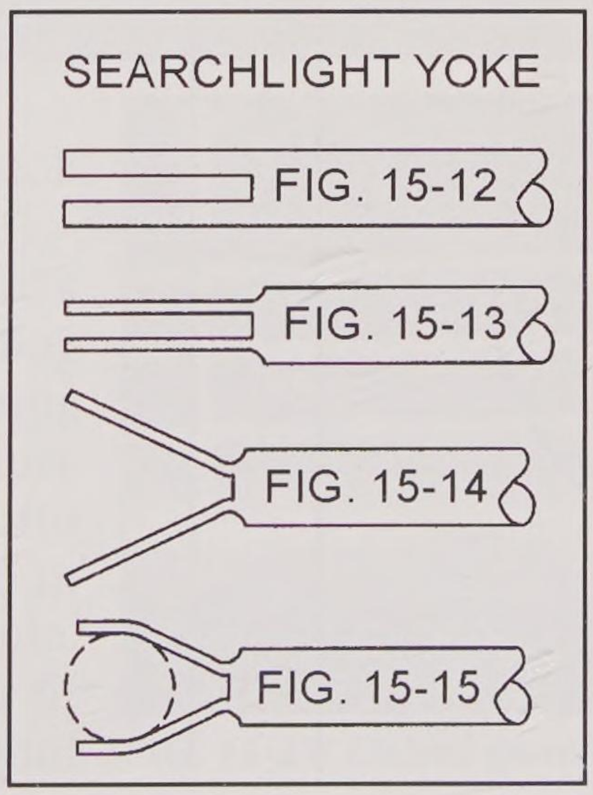
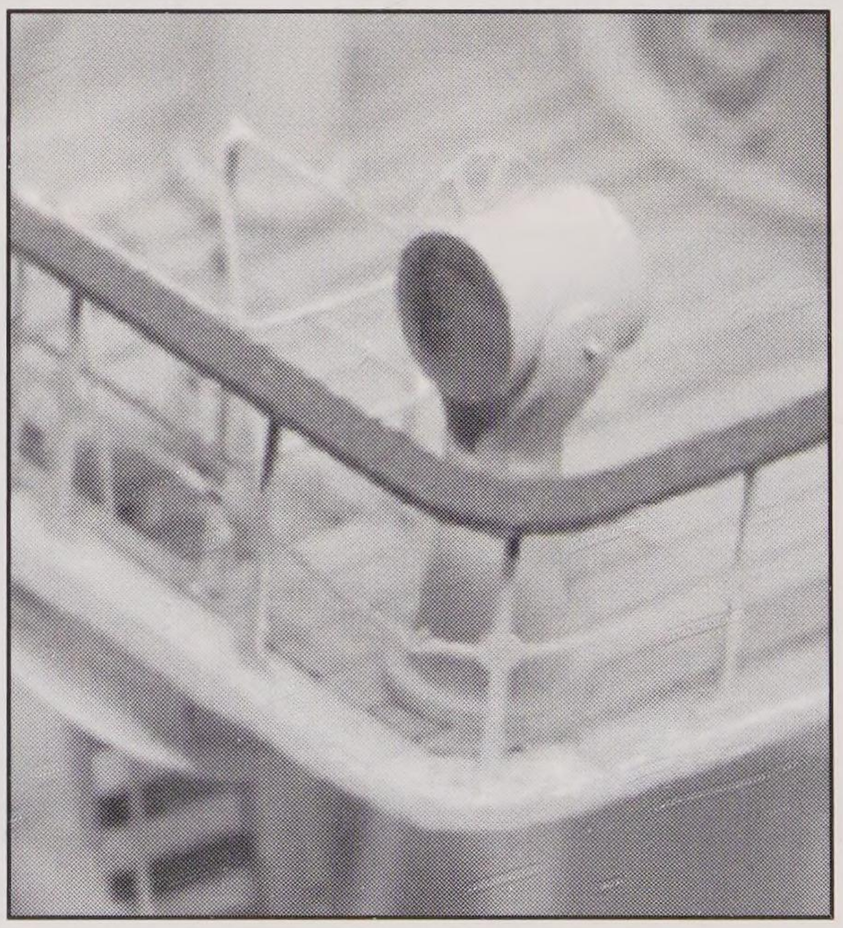


FIG. 15-16 (right):



The top was similarly prepared, but with the plan view incorporating the triangular shape. A simple wood fixture was made to assemble the two pieces (**Fig. 15-17**). The job was completed by filing off the excess material on the top and fairing the joint between the two pieces with P38. The illustration does not show the etched flap attached with glue. **Fig. 15-18** shows a gash chute in position on the hull.

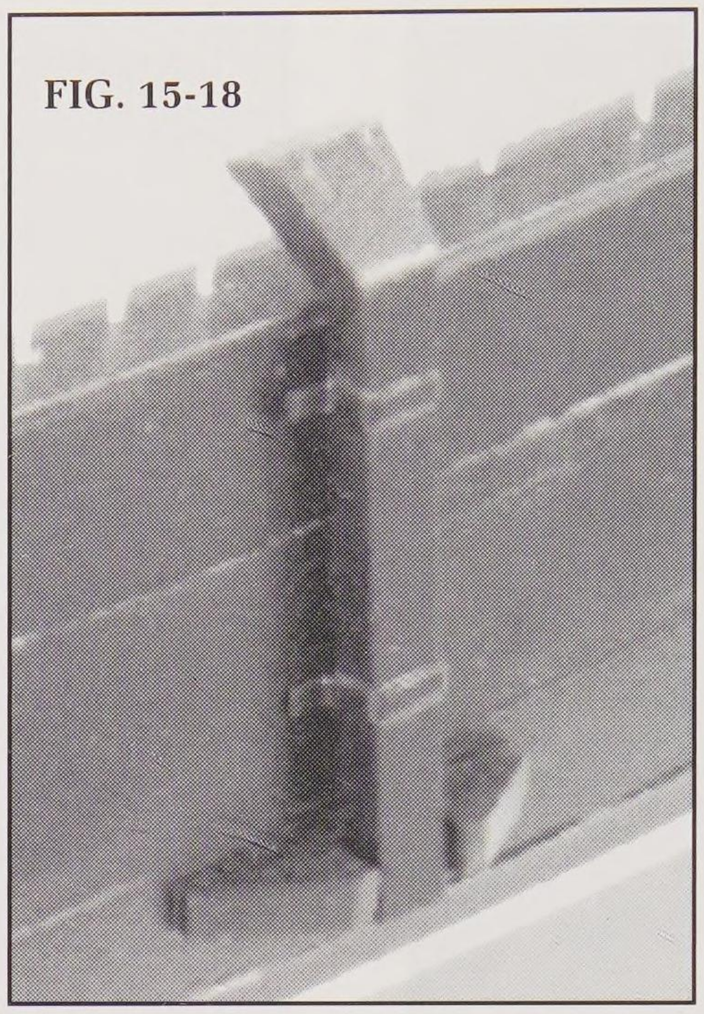


FIG. 15-18

Duilio's rudder

This was machined from a Perspex blank to the detailed drawing. Unlike modern rudders which have a streamlined cross section and rounded nose with tapered body, *Duilio's* was a great slab-sided object with six indented recesses on each face.

Both faces were covered with self-adhesive white labels to provide a surface on which to mark. The outside shape and pintle cutouts were machined. The six recesses were marked out on each face taking care to make sure they lined up. I used a ⅛" diam slot drill to mill the recesses. First, I clamped the job to a rotary table on the milling machine. Now the datums could be lined up so the sides of the recesses aligned with the machine's XY axis. After locating the slot drill visually in one corner of the recess, the X and Y table stops were set to limit travel to the shape of the recess. The Z-axis stop controlled depth. The outline of the recess was machined and the interior material removed freehand. The clamps holding the blank was moved to reach all six recesses. The operation was repeated for the obverse side (**Fig. 15-19**). The final step was to drill the pintle pin holes. **Fig. 15-20** shows the rudder painted and fitted.

Not everyone has a milling machine, so try this alternative method. Glue ABS or polycard cutouts onto a thinner rudder blank to form the recesses and eliminate the milling operation.

FIG. 15-19 – MACHINING RUDDER

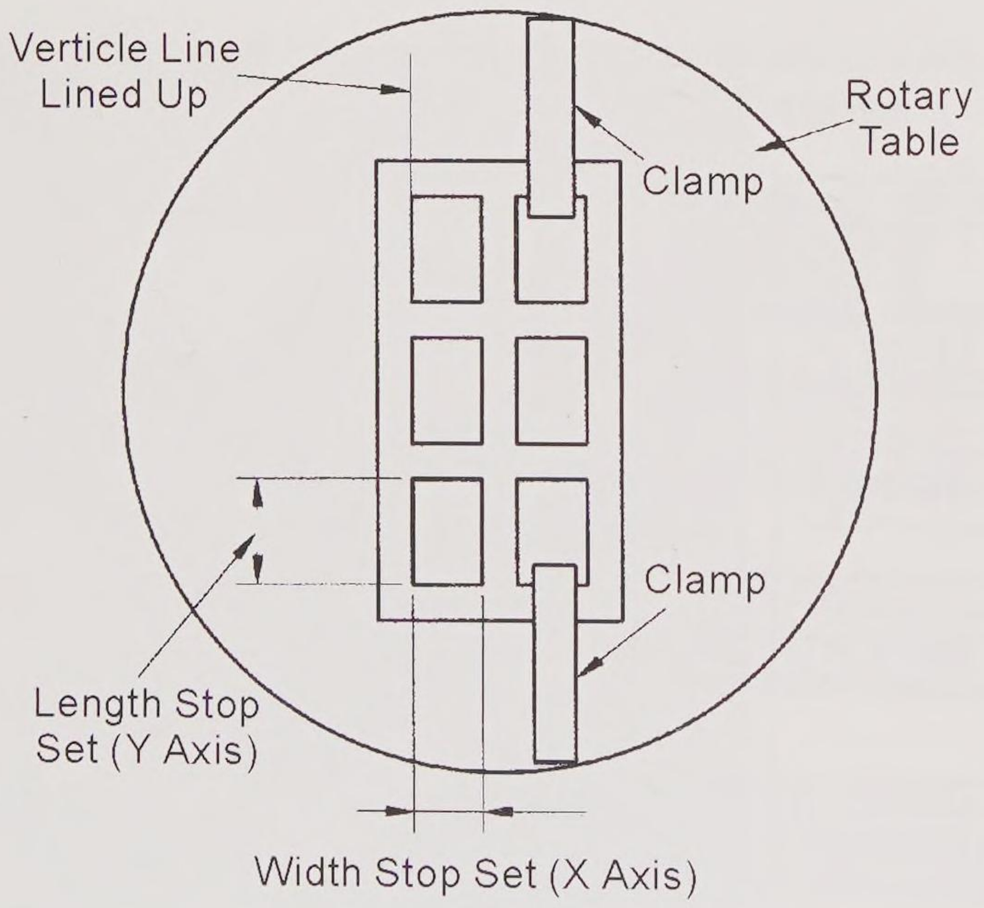
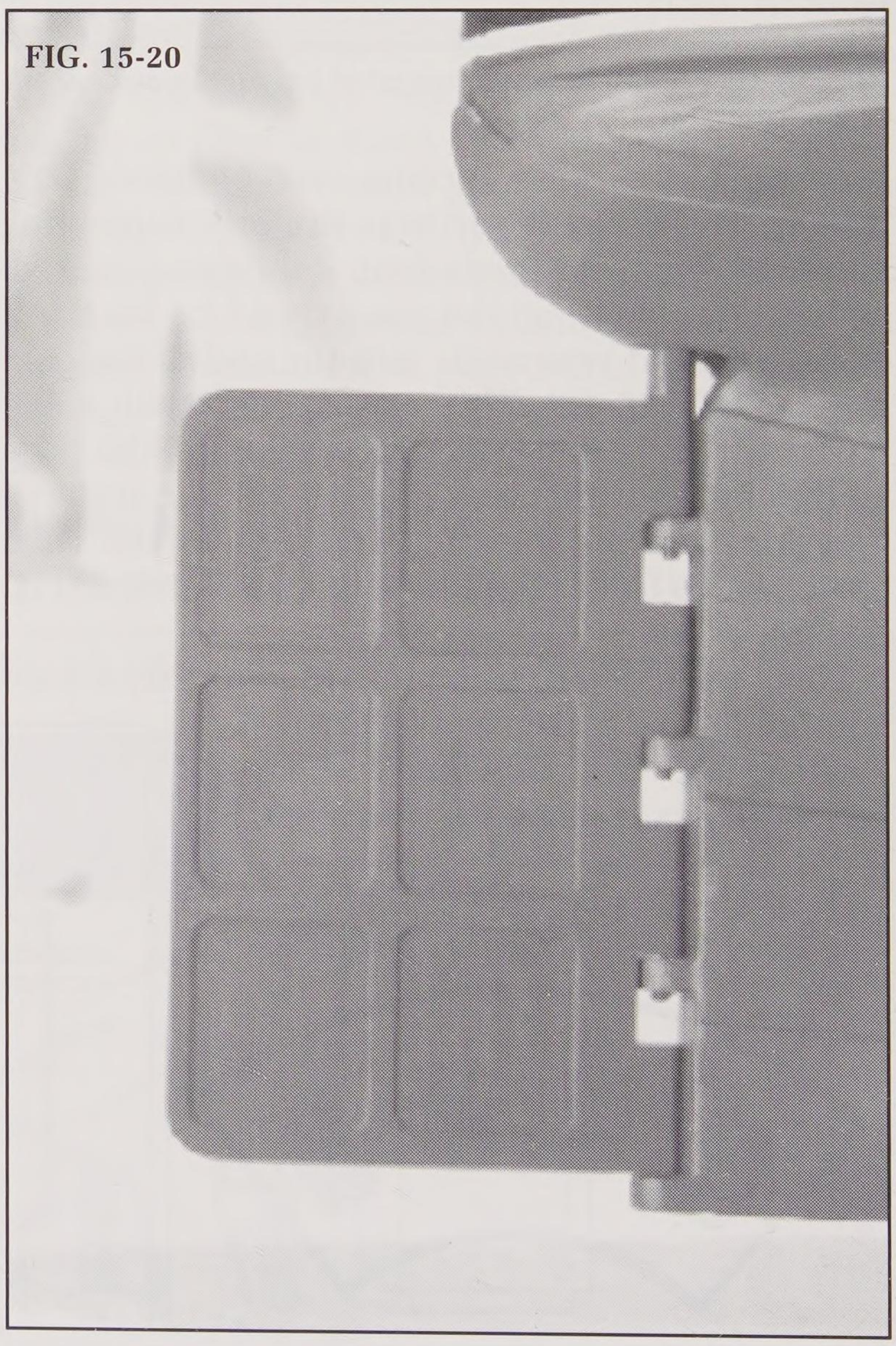


FIG. 15-20



Ram bow

A long time passed before it dawned on Naval designers that ramming was not a battle option. Several ships were built as rams; *Polyphemus* (1881) was one. In practice, the ram proved more menacing to friends than enemies. Parkes, in his *British Battleships*, sights seven occasions where friendly ships were rammed and sunk. For example, whilst on manoeuvres in the Mediterranean, *HMS Camperdown's* ram sank *Victoria* with the loss of 358 lives.

Duilio's bow torpedo tube

One of *Duilio's* peculiarities is its bow torpedo tube just under the ram bow. What effect ramming would do to the tube and its contents is open to conjecture. The tube was covered by a cap supported and operated by a complicated lever system. A chain lifted the cap to open the tube and two tricing lines, one on each side, closed it. How this light structure stood up to heavy seas is unknown. **Fig 15-21** shows the cap being glued into position. Note the rubber (eraser) protecting the paintwork.

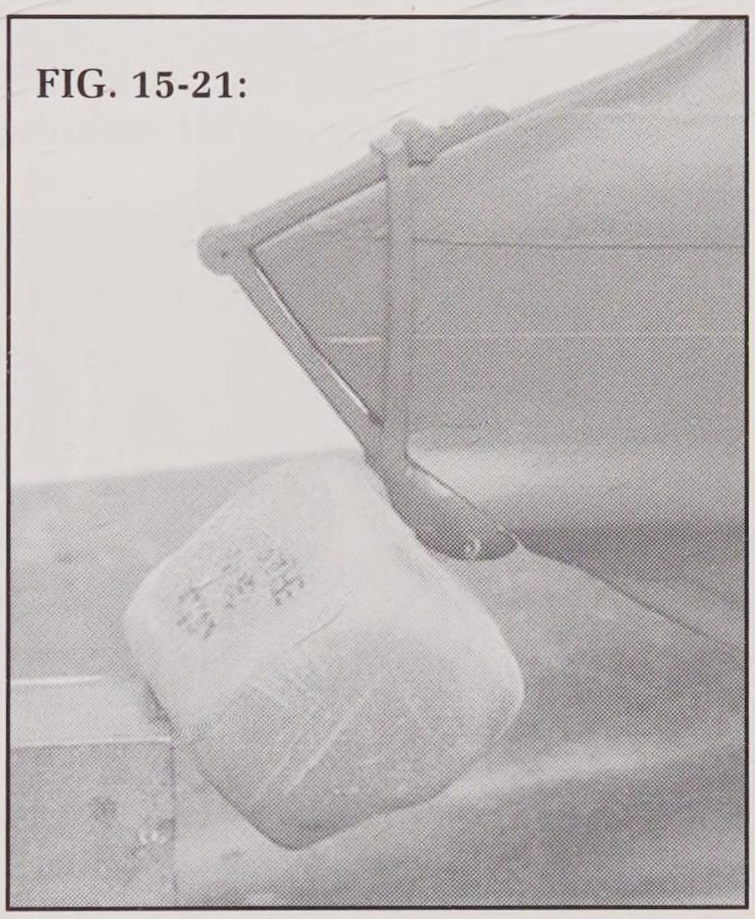


FIG. 15-21:

Main deck guardrails

Fig. 15-22 shows *Magnificent's* main deck guardrails. Stanchions were rustless wire inserted into the deck and railings were nylon tights mending thread. Each vertical and horizontal intersection had a figure eight knot or clove hitch representing the ball. This was a long and tiring job. The photo also shows the spare anchor and thin blue stripe around the superstructure. At the scale to which I am working, etched rails are much easier and look more uniform (**Fig. 15-23**).

No guardrails were shown on *Duilio's* drawings, so they had to be designed. They were the three-ball type with no capping rail. These were etched and joined like those on the flying deck. Where two lengths joined, the end stanchions were half etched in thickness, then fitted into the same hole. Care was exercised at bow and stern to fit the stanchions around the anchor beds and allow for fairleads and bollards.

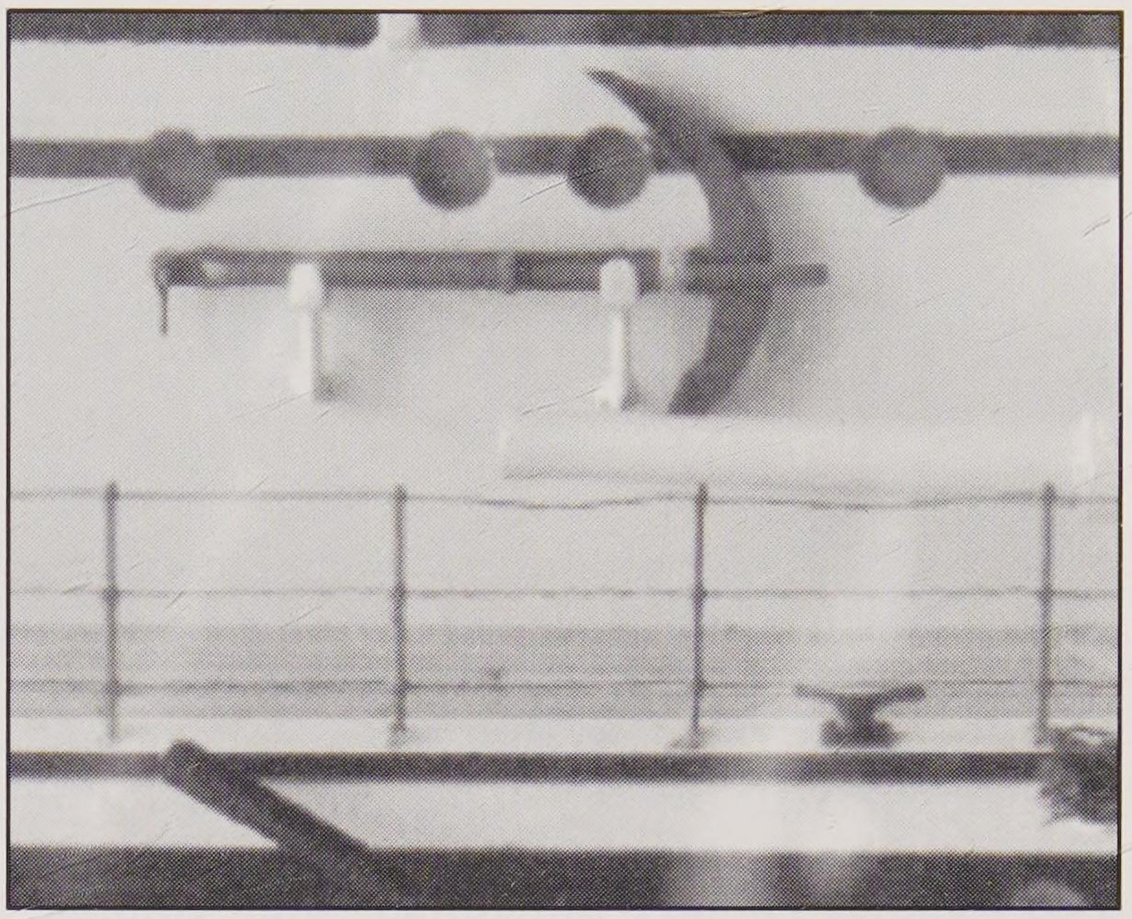


FIG. 15-22: Wire and nylon thread guardrails.

Small details

Any ship model, Victorian or not, requires a lot of small details. Those not described were straight-forward turning jobs, sometimes with etched wheels fitted. **Fig. 15-24** shows the unpainted searchlight, fire hydrant, steering wheel pedestal, and helm indicator. (Refer to **Fig. 10- 8** to see how the master binnacle was made in two telescoping parts so it adjusted for the height of the flying deck assembly.) **Fig. 15-25** is *Victoria's* main binnacle. It is on a raised platform, possibly to reduce the hull's magnetic effect.

Where an item was mounted on

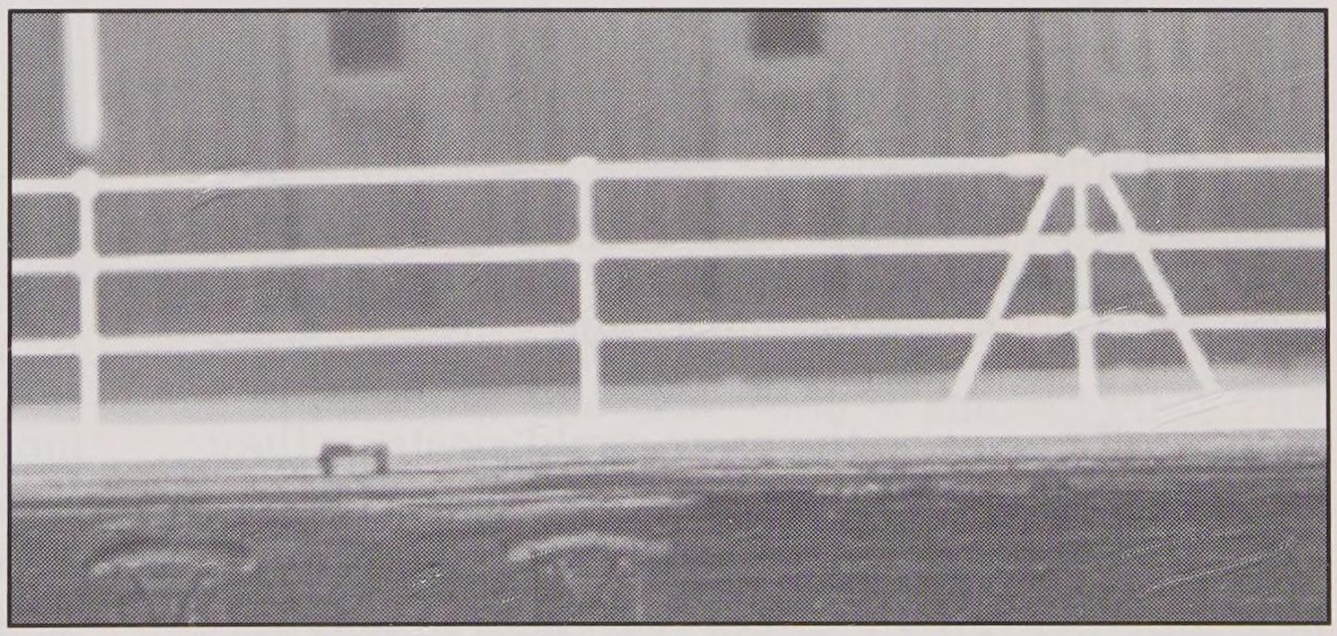
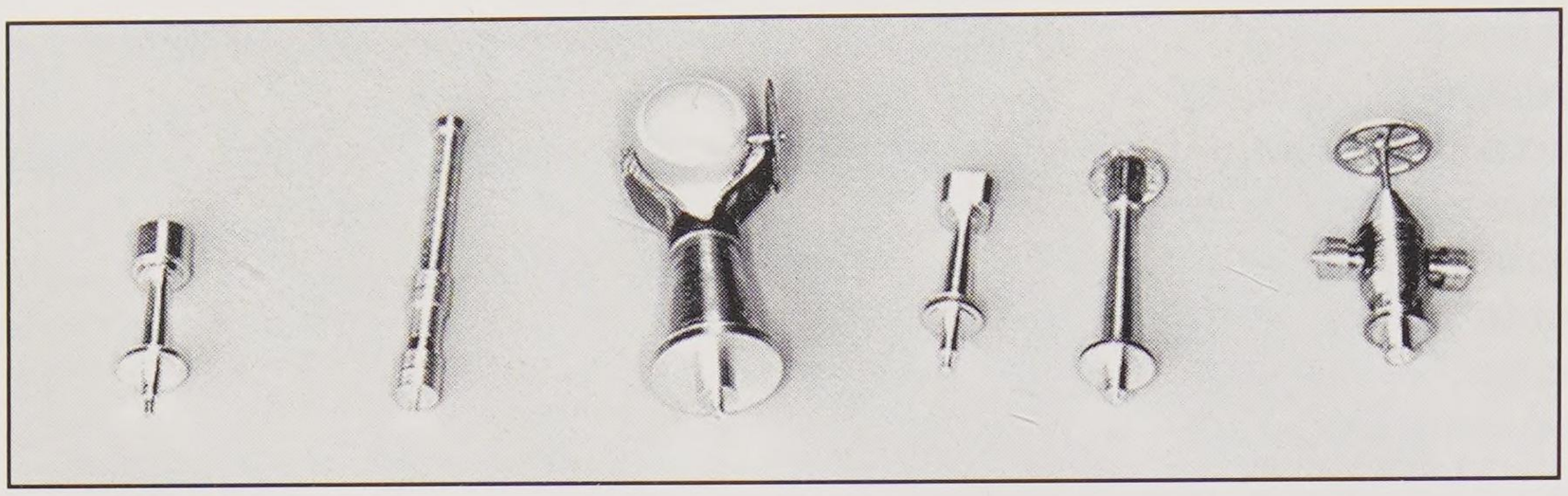


FIG. 15-23: Etched guardrails on *Duilio*.



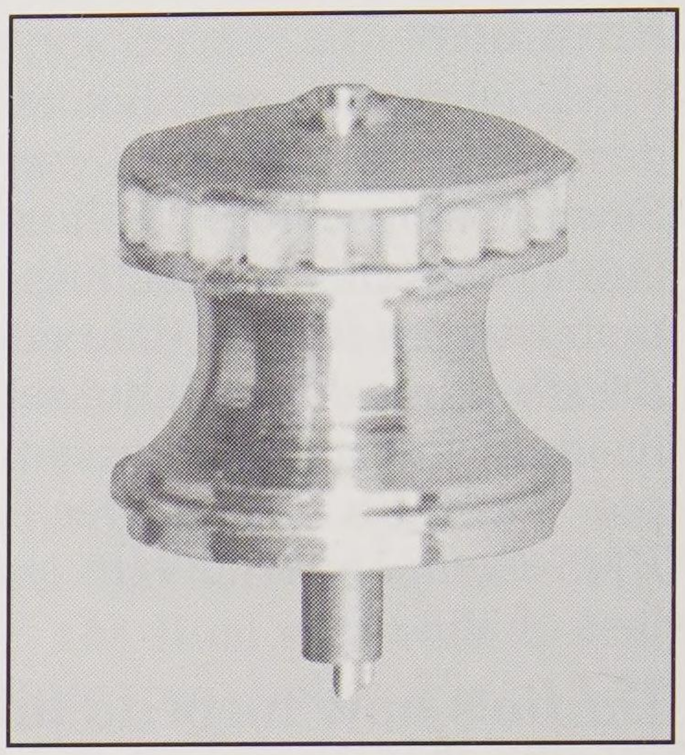


FIG. 15-24 (above): Unpainted items.

Fig. 15-26 (right): *Duilio's* main capstan.

a conical (tapered) mounting. trigonometry was used to calculate the top slide angle setting (described in chapter 12). **Fig. 15-26** shows *Duilio's* main capstan. Note the nylon gear wheel sandwiched between the top and main body to produce the square holes for the capstan bars. **Fig. 15-27** shows *Duilio's* unpainted cable stoppers. The fore awning supports are shown in **Fig. 15-28**.

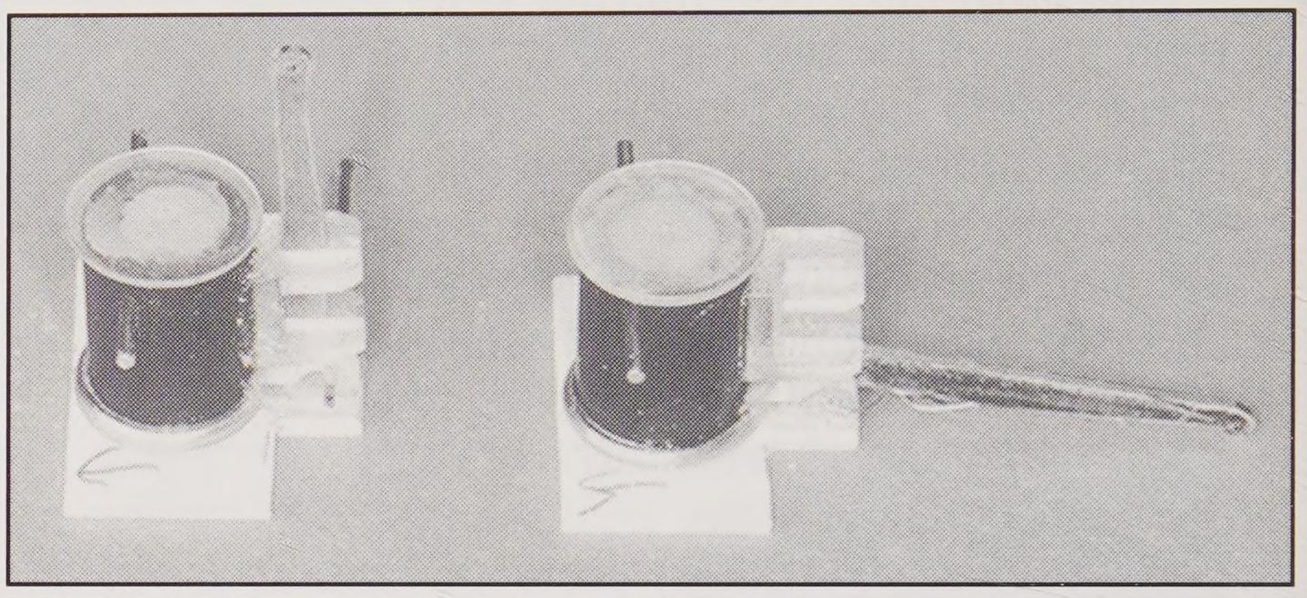


FIG. 15-27: Unpainted chain stoppers.

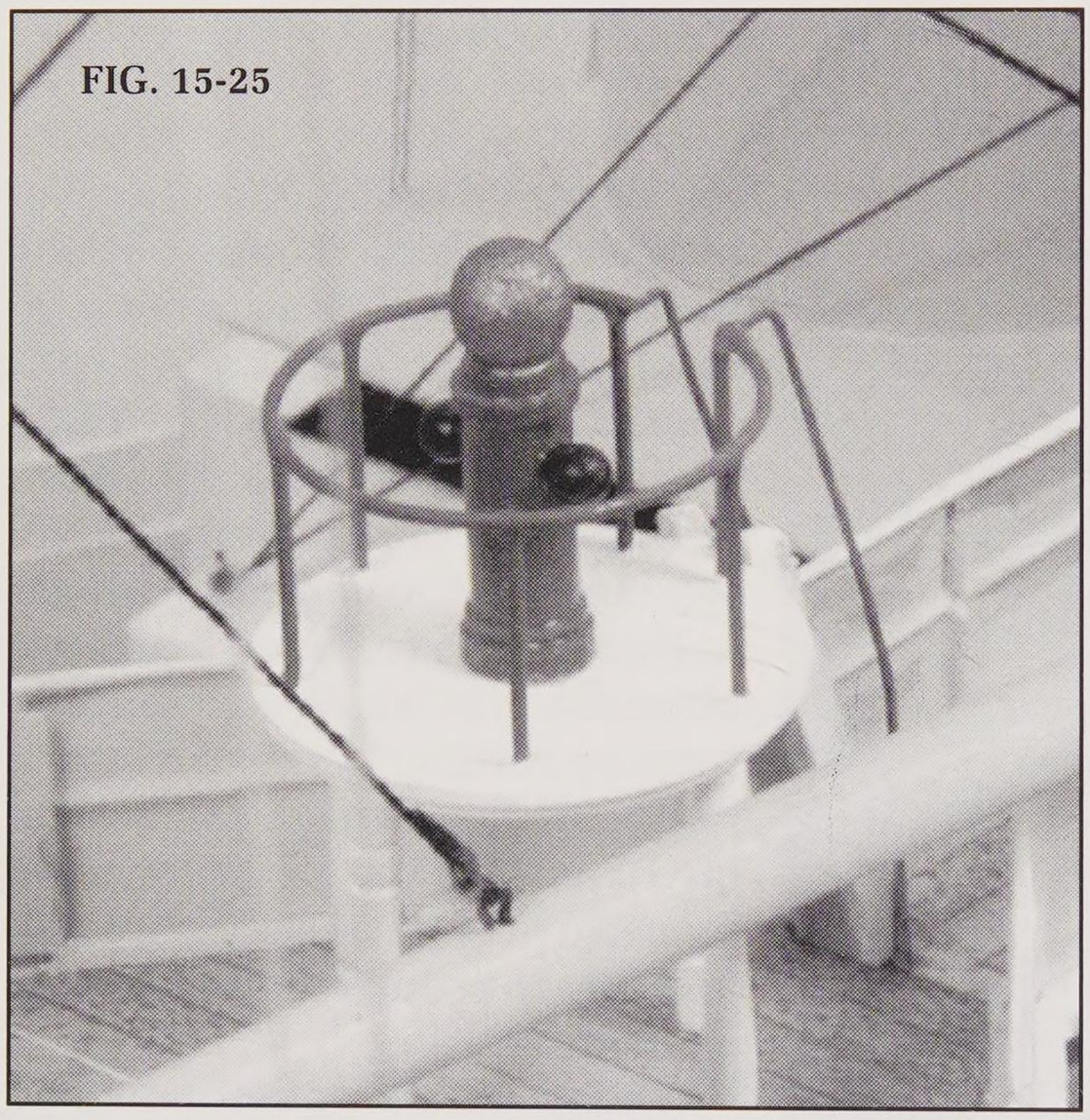


FIG. 15-25

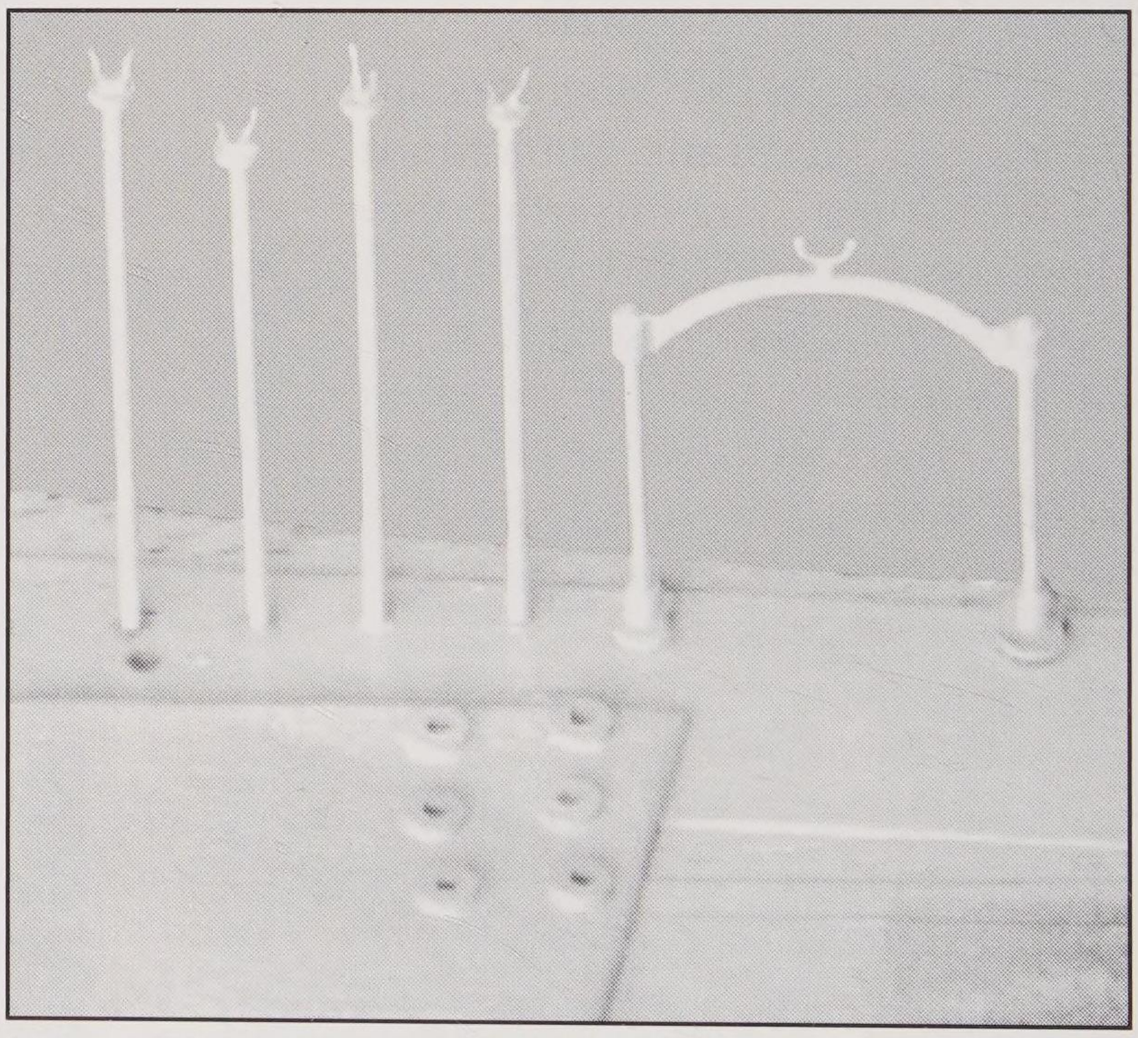


FIG. 15-28: Awning supports for the bow.

Deck clutter abounds on Victorian battleships. Different vessels have different kinds of extras. For example, Royal Navy battleships often had black stove pipes (**Fig. 15-29**). They were stowed before going into action. *Barricoes* (water barrels) were liberally spread about *Duilio's* deck as were numerous stretchers (**Fig. 15-30**). I do not know whether this was so the crew could siesta or they were expecting large numbers of casualties!

Fairleads and bollards are fitted to every ship. If large numbers are required, cast them in polyurethane resin from a silicon rubber mould. Make the mould from a Perspex master pattern. If limited numbers of one size are required, make them from Perspex, too, as this material lends itself to such work.

Before the advent of oil firing, circular coal

FIG. 15-29: Stove pipes on *Magnificent*.

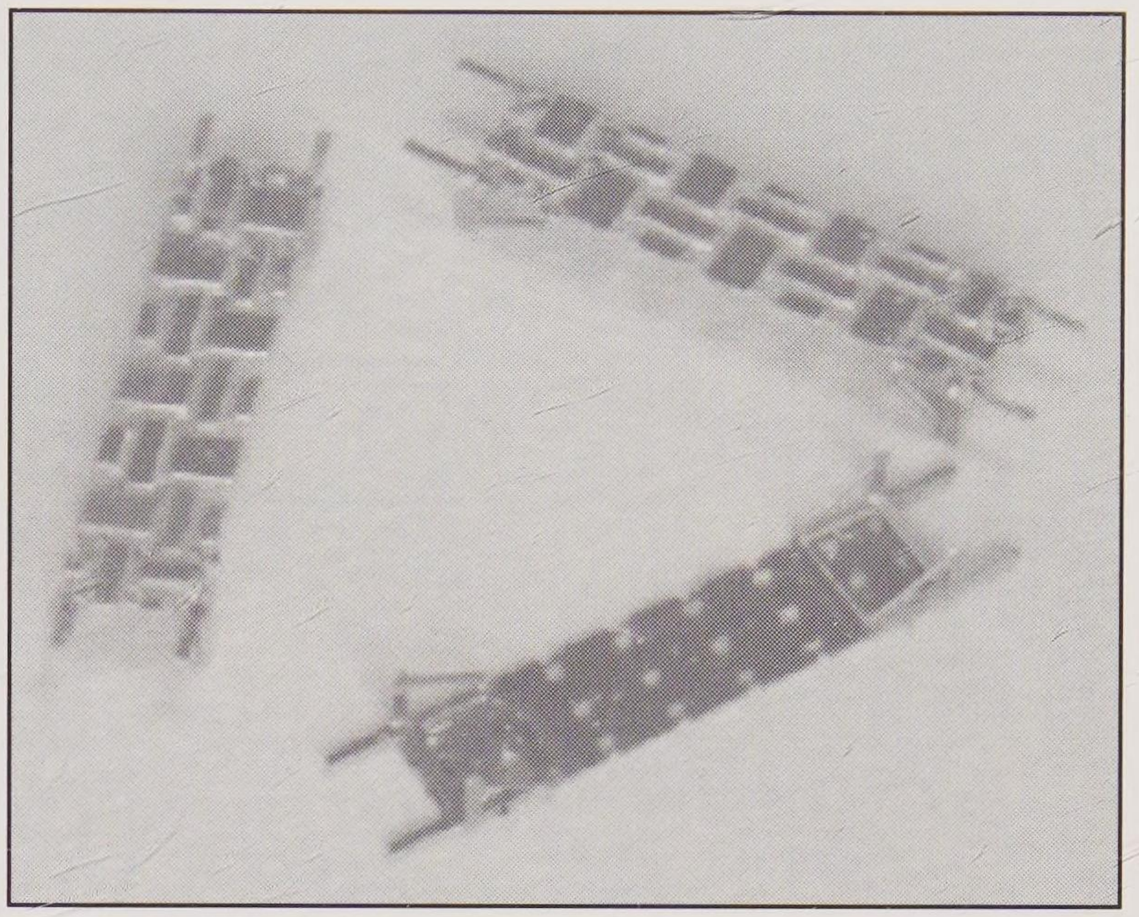


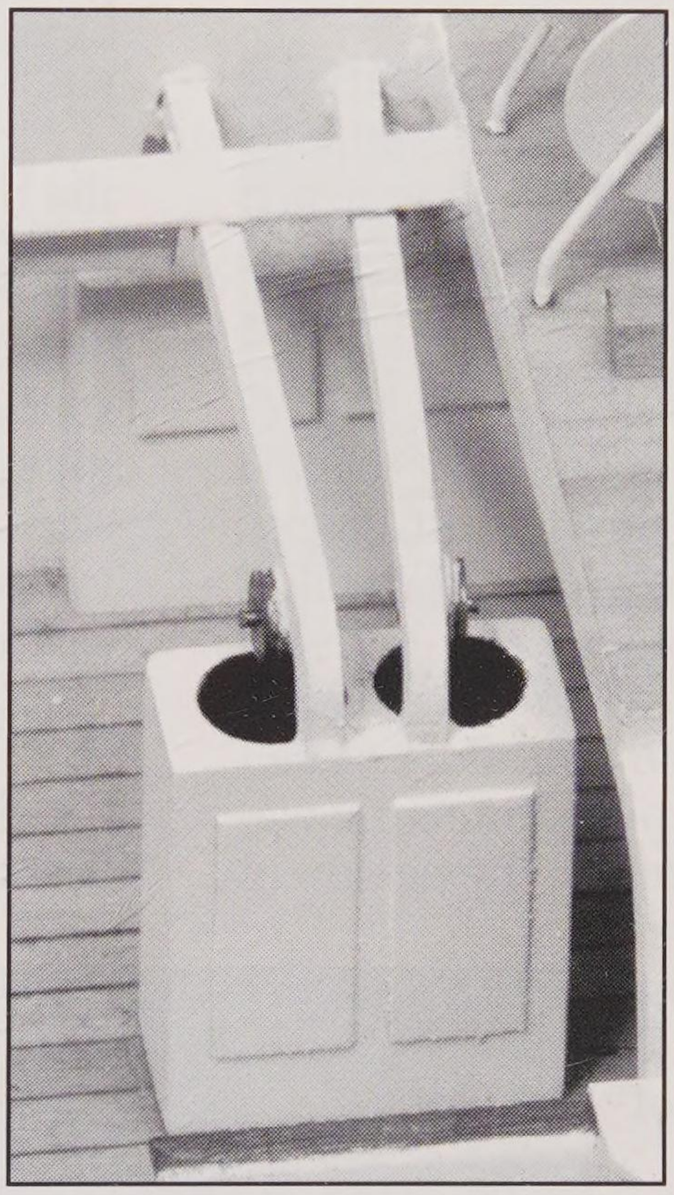
FIG. 15-30: Stretchers.

holes in the deck were abundant on Victorian ships. Their covers are best etched with a half-etched design – often a non-slip grid pattern – on the top face.

One problem with coal-fired ships was the continual need to remove the enormous amounts of ash their furnaces produced. **Fig. 15-31** shows *Empress of India's* ash hoists. Ash was hoisted up and discharged overboard.

Fig. 15-32 shows one of *Victoria's* heads (seats of ease) with its sewage outfall. The little rectangular object on the left is the cistern. Also note the Admiralty pattern anchor stowed vertically on the hull side.

One other feature that continued up to World War II was the balsa raft (**Fig. 15-33** c/s). Used for painting the ship, it consisted of twin oval section floats joined with an elementary deck. They are evocative of Victorian naval practice, as all major Royal Navy ships seemed to carry them.



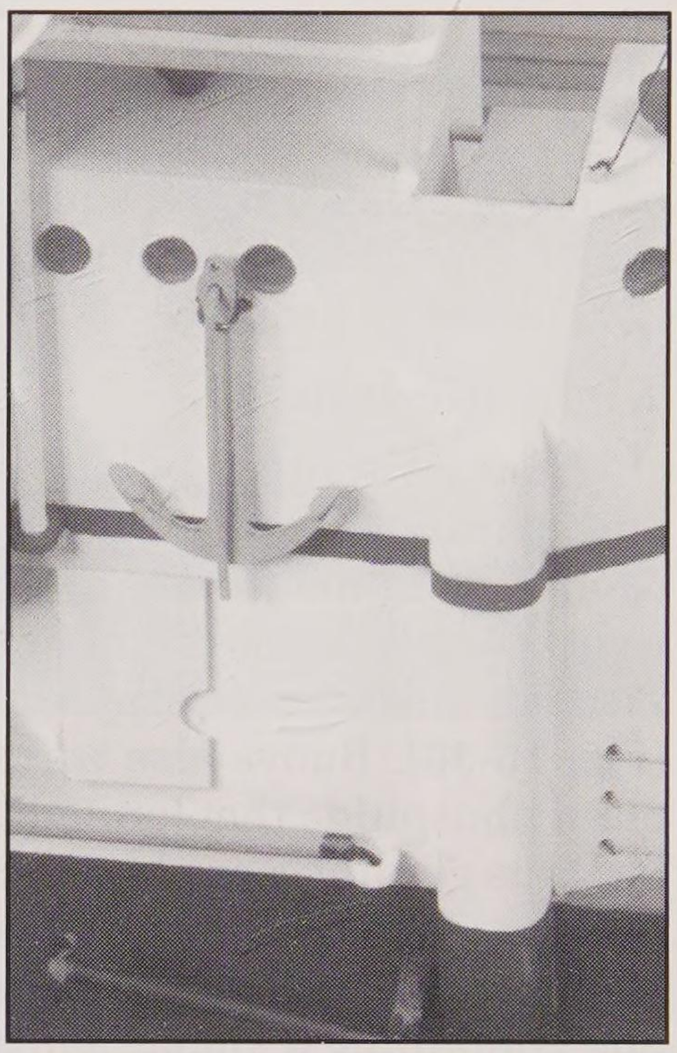


FIG. 15-31 (left): Ash hoist.
FIG. 15-32 (above): "Heads."

Skylights are etched brass lights fitted to a Perspex base. Some skylights had protective bars fitted. At these scales, bars are best etched as part of the frame. Fitting them separately is likely to provoke a severe headache, but it can be done and, if the scale is large enough, it must be tackled. **Fig. 15-34** shows *Duilio's* etched skylights on a turret.

Fig. 15-35 (c/s) is interesting in that it shows many features of a late Victorian battleship, in this case *Empress of India*. On deck are two sets of skylights with their armoured flaps in the upright position. A cowl ventilator pointing aft is between them, probably to extract air from the ship. The four-legged object is a depth-sounding machine. The two black, bar-shaped objects are davits to handle the anchors stowed beneath the Admirals walk. Double doors allow access to the Admiral's walk. The inner one, a stained glass and wood door typical of the period, is covered by a hinged armoured door shown stowed open. Working out the hinges' geometry on the outer door was quite a problem. The inner door is inset and

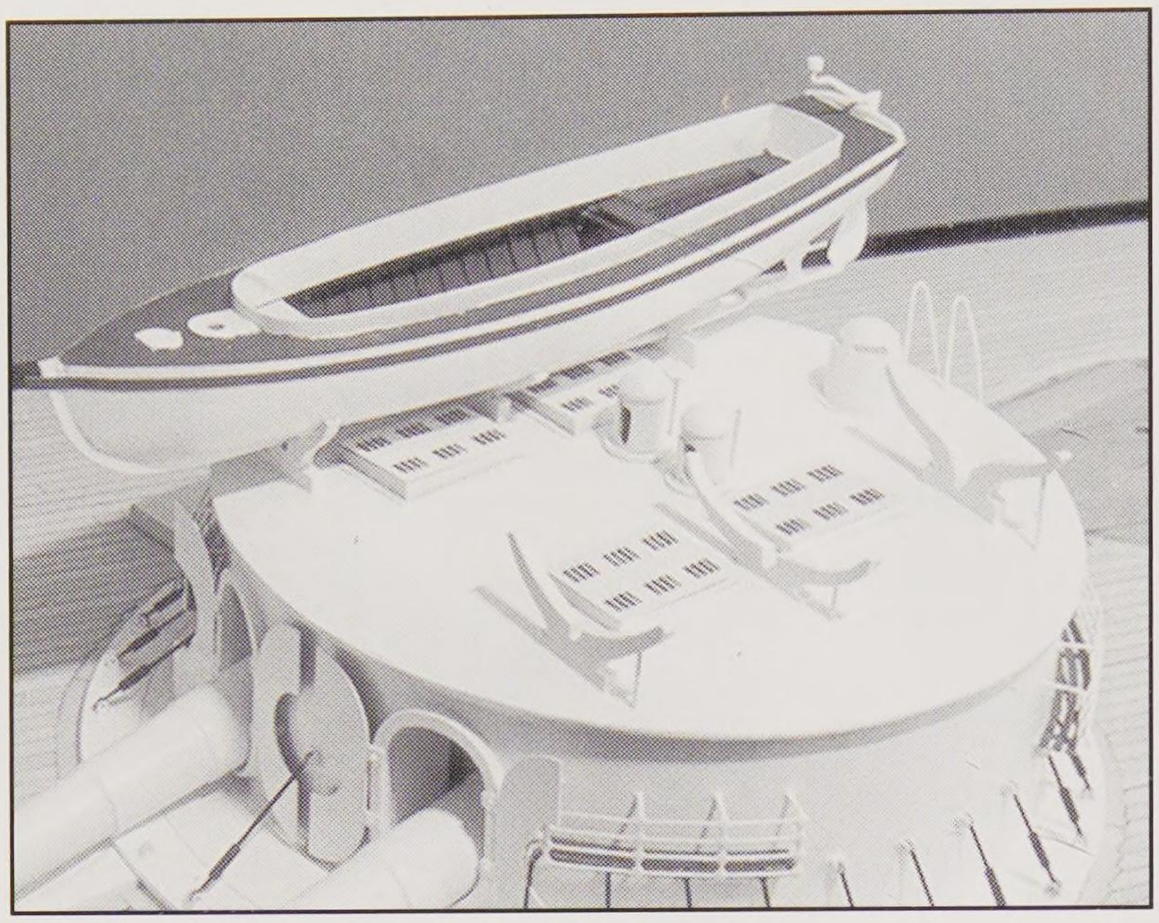


FIG. 15-34: Skylights on *Duilio's* turret.

hung vertically, but the outer door must conform to the hull's tumblehome when shut. Help! A minuscule detail is the square-section gutter just under the deck to prevent water cascading onto the Admiral's property.

Night life buoys

These were fitted to late 19th century vessels and continued up to WWII (the aircraft carrier *Glorious* had them). They had four hollow watertight copper spheres mounted at the ends of wooden crossbars equipped with rope handgrips (**Fig. 15-36**). Buoys also carried cylinders of calcium phosphide that ignited upon contacting water, thus guiding a sea-boat's crew to the person in distress. The lower sphere reputedly had two receptacles, one containing a signal whistle and the other a small bottle of brandy or other restorative!

The buoy was mounted on two sloping angle iron bars. Operating a handle released it into the sea. Although floating horizontally, the weighted calcium flares adopted an upright position and exhibited a bright light visible over a considerable distance. Releasing the buoy removed the protective covers from the calcium phosphide cylinders, allowing contact with the sea. (An earlier version floated vertically. A footrest automatically deployed on the buoy when released.)

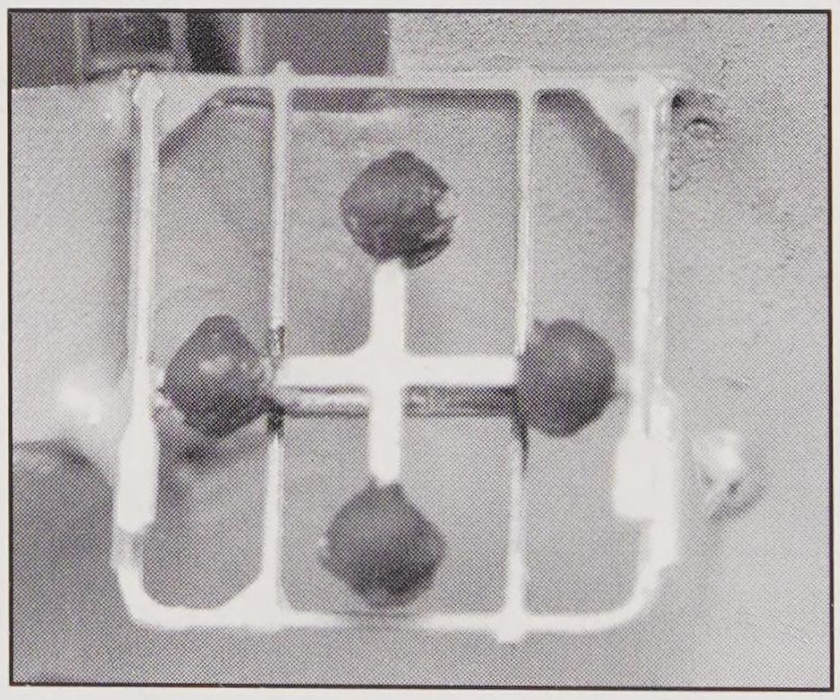


FIG. 15-36: Night life buoy.

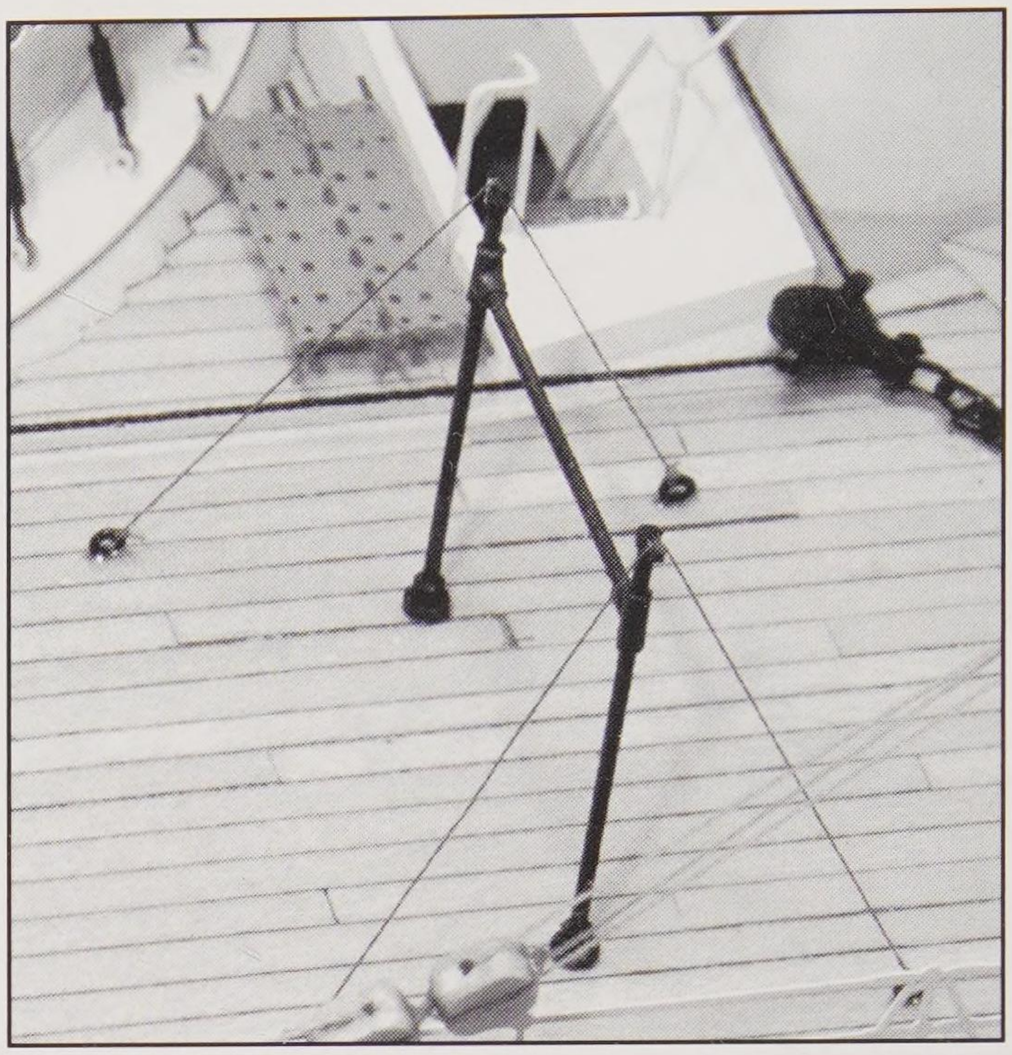


FIG. 15-37. Exercise frame.

Exercise frame

A H-structure (**Fig. 15-37**) stayed to *Duilio's* starboard deck was a mystery until, on perusing my copy of *The Navy and Army Illustrated*, I saw a similar frame and its use became immediately obvious – to exercise the crew. When sails were carried, was such exercise redundant?

A bit of lateral thinking

Believing ones initial ideas always work out the best the first time would be pleasant. That they do not is frustrating and time-consuming, but such is the nature of things. An example of my thought processes may be interesting. **Fig. 15-38** shows the exercise beam arrangement. It was decided that the joints at both ends of the horizontal bar should be made with "T" pieces as shown. The problem was how to make them? They are tiny!

Method 1: Two pieces were turned and drilled, and the end of the short piece filed concave to saddle the longer piece. These were held in the Helping Hands (**Fig. 15-39**) and silver soldered for strength, but the alligator clips collapsed the heated tube.

FIG. 15-38
EXERCISE FRAME AND T-JOINT

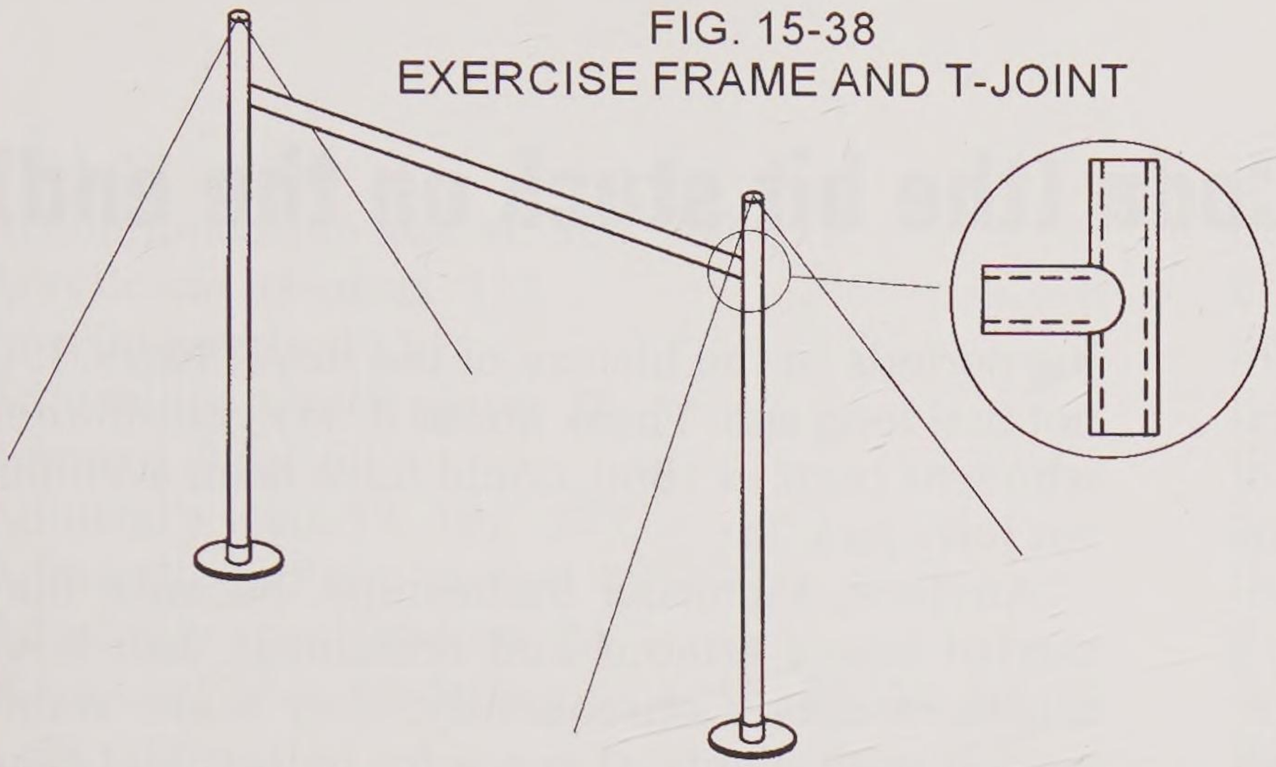
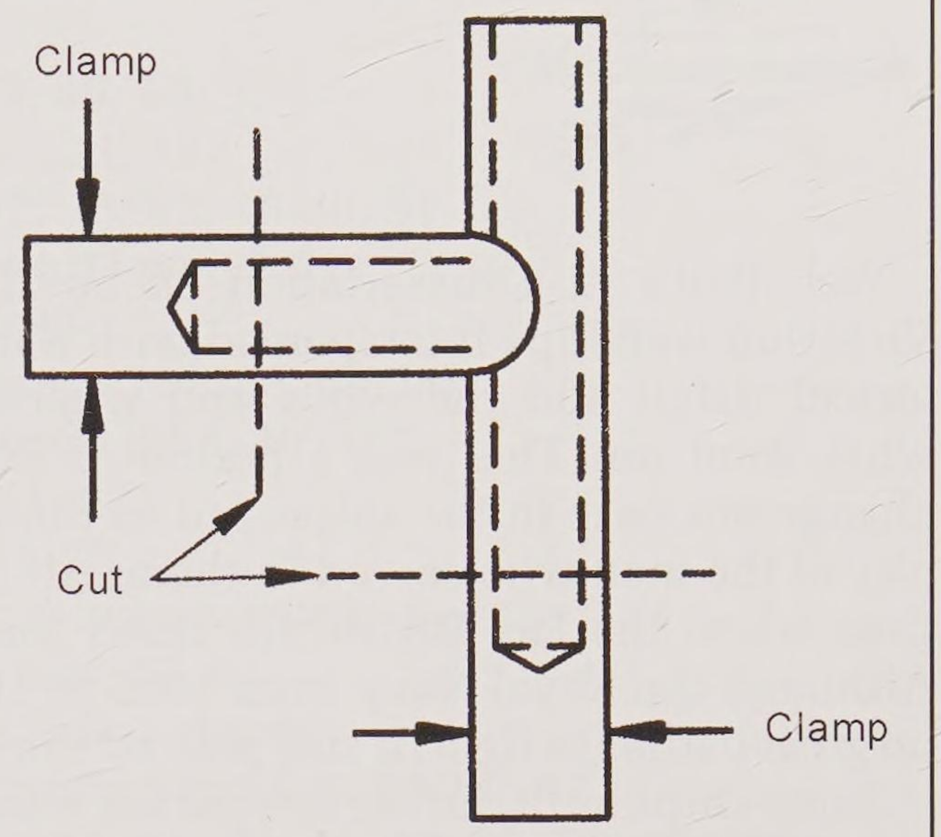


FIG. 15-40 – METHOD #3 WORKS!



Method 2: If the tube collapsed, why not support it by inserting lengths of fitted wire? This method was probably not viable due to Murphy's law (if it can happen, sooner or later it will); therefore, the fitted wire will solder in!

Method 3: It worked! Make the two components longer with solid ends; i.e., stop the drilling short. The solid ends will not collapse and can be cut off afterward (**Fig. 15-40**). Eureka!

I cite this as an example of leaning on a problem. Usually enough thought will eventually provide a solution.

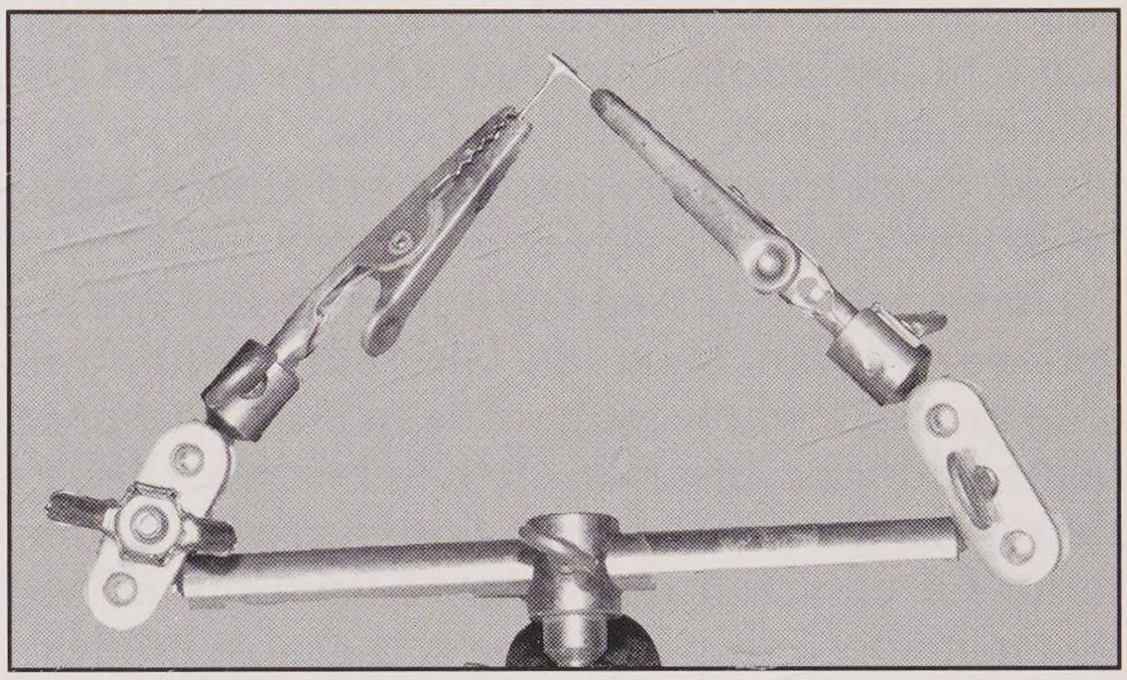
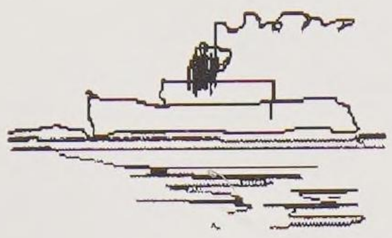


FIG. 15-39: Helping Hands at work.



Coda (the bit stuck on the end)

Well that's it, a dissertation on building late Victorian warships interspersed with a little historical detail and the whys and wherefores of what went on. This was a period of enormous change not only in the ships, but in the philosophy of the men who served in them. All during a time when the Pax Britannica ruled the world. Although the Royal Navy from 1805 to 1916 had no great battles to fight, it still policed the world.

Some ships built during this period were highly successful and moved the action onward, others were not. *HMS Captain*, designed by Capt. Coles and built by Lairds, capsized with the loss of 472 officers and men, including Coles. Only 18 survived. Such tragedies, however, are almost inevitable when Naval progress is the aim.

I have only discussed battleships, but if you are serious and want to build a late 18th century warship model, a whole range of vessels from torpedo boats through cruisers in all their forms to the battlewagons described herein will overwhelm your mind for choice. I only hope I have influenced you to model a ship from one of the most interesting periods in the history of the Royal Navy. It is not that long ago. Think about it. My grandfather, who was born in 1860, could have been a Victorian Jolly Jack Tar.

Anyhow, Victorian battleships, because they carried heavy armour and armament, had large displacements. Consequently, they make stable models with plenty of space for ballast and gear. Also, because these vessels were only about 400-feet long, a relatively large scale can be adopted without producing a backbreaking model. Their hull shape is also pretty straightforward with no anti-torpedo bulges to worry about, as these can be quite a headache if one tackles 20th century battleships.

Whatever subject you choose, carry on building ship models. It is the best hobby in the world, although for me, it has long since ceased to be a hobby; it has become a way of life.

Cheers!
Brian King
Weybridge, May 2001

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About the Author

Brian King is no stranger to shipmodellers throughout the world, having written numerous articles for modelling journals in the United Kingdom and United States.

His first book, ***Advanced Ship Modelling***, published by Nexus in 2000, attempted to not only describe advanced modelling techniques and procedures, but to explain his philosophy. His second book, co-authored with Azien Watkin, was on the technical process of photo etching.

Modelling Late Victorian Battleships is really a sequel to his first, dealing with the last 30 years of the Victorian era. This was a time of exciting development. Brian describes his four Victorian battleship models and illustrates this book with the building of the Italian battleship ***RN Duilio***. He also discusses the history and developments of the period.

Brian was trained as a mechanical engineer, but his family background of woodworking stood him in good stead. In his early forties, he became a lecturer in technical college and taught for the rest of his working life. Since retiring, most of his models have been 20th century capital ships, although the odd open boat has crept in occasionally to exercise other talents.

He has had a fair amount of success in competition. At Naviga, (a worldwide organization of shipmodelling clubs), Brian has won two gold medals, three slivers, and one bronze. At the UK's Model Engineering Exhibition, he has won 13 gold medals along with numerous silvers and bronzes.

To Brian King, building ship models is not a hobby, but a way of life, and it shows in the writing of this book.

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